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# United States Naval Medical Bulletin

PUBLISHED *for the* INFORMATION OF MEDICAL DEPARTMENT *of the* NAVY

*Issued Quarterly*
*.. by the ..*
*Bureau of Medicin*
*and Surgery*
*Washington*
*D. C.*

VOL. XXVI JANUARY, 1928 No. 1

# UNITED STATES NAVAL MEDICAL BULLETIN

PUBLISHED QUARTERLY FOR THE INFORMATION OF THE MEDICAL DEPARTMENT OF THE NAVY

*Issued by*

THE BUREAU OF MEDICINE AND SURGERY
NAVY DEPARTMENT

DIVISION OF PLANNING AND PUBLICATIONS
CAPTAIN J. M. BRISTER, MEDICAL CORPS, U. S. NAVY
IN CHARGE

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*Washington, March 20, 1907.*

The UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
*Acting Secretary.*

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# PREFACE

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It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, reports from various sources, historical essays, notes and comments on topics of medical interest, and reviews or notices of the latest published medical books.

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E. R. Stitt,
*Surgeon General, United States Navy.*

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# U. S. NAVAL MEDICAL BULLETIN

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## SPECIAL ARTICLES

### PHYSIOLOGY OF RESPIRATION IN RELATIONSHIP TO THE PROBLEMS OF NAVAL MEDICINE[1]

By EUGENE F. DU BOIS, Captain, Medical Corps, United States Naval Reserve; Medical Director, Russell Sage Institute of Pathology; Associate Professor of Medicine, Cornell University Medical College

PART I

The naval medical officer is required to know as much medicine as the doctor in civil practice, and in addition he must be thoroughly familiar with certain situations that can arise only in naval warfare. A great many of these group themselves around the problems of respiration. Let us take, for example, deep diving, altitude flying, submarine ventilation, and gas warfare. These are all recent developments of great importance to the naval medical officer, and in each one the limiting factor is human respiration.

There have been several excellent books written on these subjects and each one of them starts with a review of certain laws of physics, chemistry, and physiology. The same general principles apply throughout, and each one of these branches of warfare throws light on all the others. Therefore it seems advisable to review the subject from the standpoint of all the military specialties which deal with respiration. At the same time we shall be reviewing that branch of physiology which is of greatest help in solving the problems of clinical medicine.

In every active medical ward there are always a dozen patients with some form of respiratory distress and each one suggests a question which can perhaps be answered after a brief review of the physiology of respiration: Here in the first bed is a man with heart disease; why does he sit upright to breathe instead of lying down? Next to him is a man with failing heart and nephritis. Why does he have Cheyne-Stokes respiration with alternating periods of deep breathing and apnea? Next is a man in diabetic coma. Why is his breathing deep and slow? Why is this next man with pneumonia cyanotic?

In a brief review of the general principles of the respiration it is not necessary to go deeply into the complex laws of physics and

[1] From the Russell Sage Institute of Pathology in affiliation with the Second Medical (Cornell) Division of Bellevue Hospital, New York.

chemistry. Of course, the reader who is well versed in modern science will find the explanations much easier, but it is possible to present matters fairly simply to the man of the ordinary medical education. It is, however, to be hoped that this review will merely serve as an introduction to one of the most fascinating of all branches of physiology. We are fortunate in having several readable, up-to-date books on this subject, notably those of Haldane (1), Barcroft (2), Meakins and Davies (3), and Means (4).

The whole process of respiration is a beautiful example of the factors of safety provided in the animal organism and the powers of adaptation to changed conditions. We must focus our attention always on the respiration of the cells of the tissues, their need for the absorption of oxygen, and elimination of carbon dioxide. Everything else in the haemato-respiratory system is secondary to these two needs. Of the two, the more important is the absorption of oxygen, because cells die quickly without this gas. The carbon dioxide which is produced by the action of oxygen in the cell has become the regulator of respiration, and it so happens that the rate of ventilation sufficient to remove the $CO_2$ is more than sufficient to supply the $O_2$.

Nature has found in hemoglobin a medium beautifully adapted to the transportation of oxygen. The shape of the absorption curves of blood for $O_2$ and $CO_2$ give the best possible results for the least amount of effort and, in addition, the two gases act upon the blood in such a manner that each one helps the transfer of the other between blood and tissues or lungs.

When man is exposed to an abnormal environment there is usually first an encroachment upon the factors of safety and then an adaptation of the various systems involved, the muscles of respiration controlled by the respiratory center or centers, the acids and bases of the blood, the hemoglobin, the circulatory apparatus, the vaso-motor system, and finally the cells. In disease, when one or several of these systems are damaged, the others do their parts in compensating for the disturbances in function. When they are not completley successful the symptoms become manifest to patient and physician.

## The Environmental Air

The composition of pure atmospheric air is usually given as oxygen, 20.93 per cent; carbon dioxide, 0.03 per cent; nitrogen, 79.04 per cent. The figure for the inert gas, nitrogen, includes the 0.94 per cent of the inert gas argon and also minute traces of hydrogen and various rare gases of little importance. Careful analyses made in different parts of the world show that the outdoor air is extremely uniform in its composition even in the neighborhood of cities. It takes a bad

fog in a large smoky city like London to raise the $CO_2$ to 0.14 per cent. Incidentally, this same smoke, held down by fog, may contain enough carbon monoxide to reach a concentration of 0.01 per cent in the streets and perhaps cause symptoms in persons already in bad health. The fog in London is merely mentioned as an extreme case, because on a day with a moderate breeze one can go to the window of a city building and obtain a sample of air pure enough to standardize a delicate air analysis apparatus.

*Properties of gases of air*

| Gas | Molecular weight | Coefficient of solubility in $H_2O$ at 0° C. | Weight of 1 liter (grams) | Volume of 1 gram (liter) |
|---|---|---|---|---|
| Oxygen, $O_2$ | 32.000 | 0.049 | 1.4292 | 0.6997 |
| Carbon dioxide, $CO_2$ | 44.005 | 1.7 | 1.9652 | .5089 |
| Nitrogen, $N_2$ | 28.016 | .023 | 1.2542 | .7973 |
| Water vapor, $H_2O$ | 18.016 | --- | --- | --- |

Let us now examine the properties of these gases contained in air. They all have molecular weights that are much greater than that of hydrogen, which is only 2. Therefore, they diffuse much more slowly than hydrogen, since the rate of diffusion of a gas is inversely proportional to the square root of the molecular weight (density).

The whole process of breathing depends upon the partial pressures of the gases and their rate of diffusion through the alveolar walls into the blood and from the blood to the tissues.

Every gas has its own coefficient of solubility in different liquids, and this is independent of its molecular weight. Gases are more soluble in cold than in warm liquids, as is shown by the bubbles which rise in water as it is heated, and even before it boils. The coefficient of solution of oxygen in water is very low, and if water or salt solution or serum flowed in our veins instead of blood, it would contain only 2.4 cubic centimeters per liter, instead of 176 cubic centimeters per liter, as is the case with normally oxygenated blood. Carbon dioxide is much more soluble, but it could not be transported in sufficient amount were it not for the hemoglobin and other buffer substances which hold in combination alkali that can be supplied to bind the $CO_2$ as alkali bicarbonate. Nitrogen, the inert gas, is the least soluble of all, and it is such a useless gas that Nature has provided no special means for its transportation. When we come to the discussion of caisson disease we shall see that the whole trouble lies in the slow transportation of nitrogen out of the tissues.

This brings us to the question of partial pressures which is much more important than the percentages of the gases. A candle or

other flame will burn according to the percentage of oxygen present, whether the atmospheric pressure be normal, increased, or decreased. It is not so with the animal organism. The percentage of the gas counts for nothing; it is the amount of the gas pressing against the living membrane. We are always under a pressure of gas; ordinarily this is sufficient to support a column of mercury 760 millimeters high. This atmosphere which presses against us is made up not only of the oxygen, nitrogen, and carbon dioxide, but also of water vapor. In a mixture of gases, when no chemical action occurs, each gas behaves independently, the properties of the gaseous mixture being the sum of the properties of the constituents. Thus the total pressure of a mixture of several gases is equal to the sum of the pressures which each gas would exert were it alone present in the volume occupied by the mixture. This is known as Dalton's Law of partial pressure. At body temperature and 760 millimeters of pressure, the air in the lungs is saturated with water vapor which exerts a partial pressure of 47 millimeters. The total pressure is 760 millimeters, and, therefore, this leaves $760-47$ mm. $=713$ mm. for $O_2$, $CO_2$, and $N_2$. If the alveolar air contained 5.8 per cent $CO_2$ the partial pressure of this gas would be $\frac{713}{100}\times 5.8=41.3$, etc. According to Dalton's Law, the alveolar air, being saturated with water vapor, would have the same partial pressure of water vapor, 47 millimeters, at extremely high altitudes. Haldane points out that if the total barometric pressure is reduced to 100 millimeters the water vapor takes up such a large proportion of the air in the lungs that life becomes impossible, even if the man is breathing pure oxygen. This is the absolute "ceiling" for aviators unless they fly in inclosed chambers.

Another example of the effect of this law is found in deep diving. When a man is under 30 feet of sea water he is exposed to a pressure of two atmospheres. This doubles the partial pressure of the oxygen, and this is of some help to him in performing work, but it also doubles the partial pressure of the $CO_2$, which is such a great hindrance that the rate of ventilation must be increased in proportion to the depth to which the man descends.

When a liquid is exposed to a mixture of gases each gas dissolves in the liquid according to its coefficient of solubility and in direct proportion to its partial pressure. When the gas and liquid come into equilibrium the pressure from gas to liquid is exactly equal to the pressure of the gas from the liquid. A liquid may dissolve many gases simultaneously. As a rule, the diffusion of a gas into a liquid and through a liquid is slow unless the liquid is spread in a very thin layer and agitated so as to expose it thoroughly to the gas. In a quiet vessel the diffusion of gases in the liquid is in direct proportion

to their coefficients of solubility and in inverse ratio to the square roots of their molecular weights. The same holds good for the rate at which they diffuse through a porous membrance, and if a mixture of gases be placed in a vessel with a window covered with parchment or unglazed porcelain, the light gases, such as hydrogen, will pass out more rapidly than the heavier gases. This principle has been used in a device to detect the leakage of hydrogen from balloons, but in this case the hydrogen passes into the closed vessel.

The percentage composition of the atmosphere is the same at sea level as at the top of a mountain, but the weight of the atmosphere compresses the air so that the pressure at sea level will support a column of mercury 760 millimeters high, while on a mountain 19,000 feet high it will support a column only half this length. According to Boyle's Law, the volume of gas at constant temperature varies inversely as its pressure. Thus, if we double the pressure we halve the volume. There are some minor deviations from this law when we reach high pressures, but these have no bearing on problems of physiology. Heat will cause gases to expand and, according to the "Law of Charles and Gay-Lussac" all the common gases expand for each rise of 1° in temperature, by a constant fraction of their volume at 0° C. This fraction is about 0.00366 $\left(\frac{1}{273}\right)$. The absolute zero is −273° C. and, theoretically, all gases should shrink to nothing at this temperature, but they turn into liquids or solids before they are cooled to this extent and cease to obey gas laws. If a certain volume of gas were kept under constant pressure and heated from 0° C. to +273° C., it would double in volume. There are some deviations from this law also but they do not affect our calculations in physiological problems. As a matter of fact, Boyle's Law has not much effect on the physiological processes, since the lungs of man are at a practically constant temperature, but its chief application comes in methods of air analysis. All gas analyses are reduced to the standard conditions of 0° C. and 760 millimeters pressure. It is convenient to have such a standard because, under the same conditions as to pressure and temperature, all gases contain, in equal volume, the same number of molecules. Therefore, the total masses of equal volume will be proportional to the molecular weight of the gases. This is Avogadro's Principle and it is used constantly in determining the volume that will be occupied by a certain weight of gas. Thus, in a respiration experiment we may determine the oxygen consumption by the shrinkage in volume of a spirometer or by the loss in weight of a steel cylinder from which the gas is delivered as consumed.

It will help us to remember the gas laws if we realize that each gas is composed of a large number of very small molecules, each of which is keeping up a bombardment in all directions. We can actually see

the effects of such a bombardment when we watch the brownian movement of tiny particles under a microscope. The pressure of a gas is caused by such bombardments. Therefore, if we take a certain volume of gas with a certain number of molecules and press them into half the space they formerly occupied the pressure (bombardment) will be doubled. (Boyle's Law.) Now the product of the pressure and volume of a gas is equal to two-thirds the total kinetic energy of its molecules and the mean kinetic energies of all gases are identical at the same temperature. Heat increases the kinetic energy and it therefore must increase it equally for all gases, either expanding them at the same pressure or increasing the pressure at the same volume. (Law of Charles and Gay-Lussac.)

The pressure of a gas is dependent on the number of molecules in a given space, and this is the same whether the molecules be light or heavy. (Avogadro's Principle.) If a light molecule is to exert as much kinetic energy as a heavy molecule, it must have a greater velocity. The kinetic energy of any moving body is equal to half the product of its weight by the square of the velocity ($\frac{1}{2}$ w. $V^2$). Therefore the velocities of the molecules of the different gases are inversely proportional to the square roots of their masses, molecular weight. (Graham's Law of Diffusion.) A molecule of hydrogen at 0° C. would move at the terrific speed of a mile a second if it had a free path, but the actual speed is much less than this on account of its frequent collisions with other molecules.

### Transportation of Gases in the Blood

A small animal, such as an insect, has no part of the body at any great distance from the surrounding air and therefore the problem of transporting gases to and from the tissues is a simple one. In a large animal, such as man, the deep tissues are separated from the air by large masses of materials which block the diffusion of gases. We can compare the respiration of an insect to the ventilation of a small canvas tent, the respiration of a man to the ventilation of a battleship. The battleship needs ventilating fans and ducts, otherwise men would suffocate in the compartments below the water line.

Man's ventilating fans transport the air only as far as the depths of the lungs. Beyond this point the gases must be carried by the blood. We have seen that the solubility of oxygen in water is very slight. It is even less soluble in blood plasma, and Bohr found that 100 cubic centimeters of blood plasma under ordinary conditions holds only 0.24 cubic centimeter of oxygen, whereas 17.4 cubic centimeters are present in combination with hemoglobin. Only $\frac{1}{73}$ of the total is in solution and we should therefore require a blood flow seventy-three times as great if we depended on solution alone. It is the

chemical combination of oxygen with hemoglobin that solves the question of transportation. Hemoglobin is an organic substance with a large molecule containing a definite proportion of iron. There is a fixed and simple relationship between the oxygen capacity and the iron, one molecule of combined oxygen corresponding to one atom of iron. Hemoglobin is carried entirely in the red blood cells in the body, but it will combine with oxygen just as readily when in solution. It will also combine with carbon monoxide and nitrous oxide. The amount of oxygen that will be taken up by hemoglobin is to a certain extent proportional to the partial pressure of the oxygen to which it is exposed. It takes it up best at the pressure to which it is ordinarily exposed in the lungs. Once saturated it can hold no more oxygen no matter how high the pressure. We can make a rough analogy to a man who is served meals of different sizes. When given a small meal he takes all that is offered but does not get enough food into his stomach. When given an average, good meal he gets plenty and almost fills his stomach. If offered a meal ten times this size he can not possibly eat much more.

This phenomenon in the case of hemoglobin is caused by the peculiar but fortunate shape of its absorption curve. This is shown in Figure 1, which gives the curve actually obtained by Doctor Block on his own arterial and venous blood. When exposed to an oxygen tension of 20 millimeters the hemoglobin became about 40 per cent saturated and contained about 7.5 volume per cent oxygen. Exposed to 40 millimeters oxygen the saturation rose to about 75 per cent—that is, it almost doubled with the doubling of the oxygen to which it was exposed. A second doubling of the oxygen tension from 40 to 80, however, only increased the percentage saturation from 75 to about 95 per cent. On this curve the dot A, at 95 per cent, represents the usual saturation of oxygen in the arterial blood. V, at about 64 per cent, represents the usual saturation of venous blood. Between these points is the normal range under conditions of health and quiet life. The lower part of this range is on the steep slope of the curve, where a little change in the oxygen tension of the air gives the greatest efficiency. In cases of exercise or ill health or bad air the V point goes lower on the curve and perhaps the A point also. This shifts the range to the most efficient part of the curve. On the other hand, we do not, under ordinary conditions, obtain any particular benefit from increasing the oxygen tension over 80 millimeters, and a healthy man at rest can not notice any change or benefit or sense of exhilaration when he begins to breathe pure oxygen.

The position of the curve of absorption of oxygen by hemoglobin is modified by the amount of carbon dioxide in the blood. Fortunately the accumulation of $CO_2$ helps to drive $O_2$ from the blood and

the diminution of $CO_2$ helps to increase the absorption. It will be noted that there are two lines in Figure 1. The upper is that of arterial blood, the lower is that of venous blood. The physiological importance of this is not very great, but it has the effect of making the rise from V to A a little steeper and therefore slightly more efficient. Later we shall see that the amount of oxygen in the hemoglobin makes a similar but much more important shift (Bohr Effect) in the combining curve of $CO_2$.

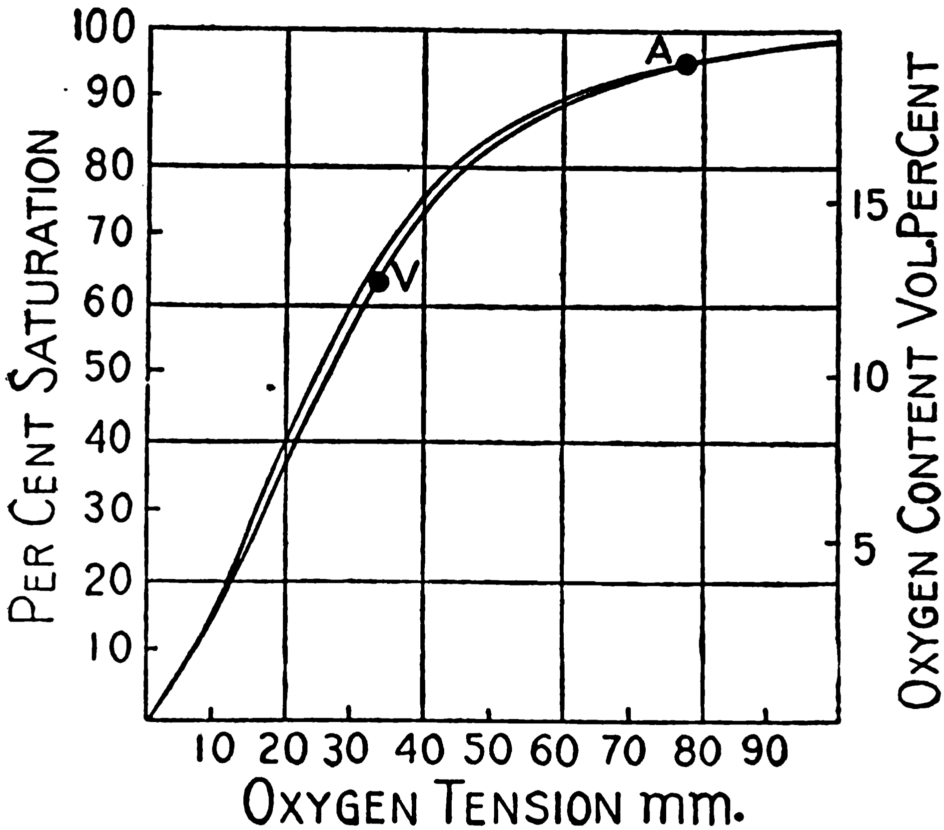


FIG. 1.—The Oxygen Dissociation Curve for Block's Blood

(The ordinate denotes the quantity of oxygen contained in the blood, shown at the right as volumes per cent, and at the left as percentage saturation. The abscissa denotes the tension of oxygen in millimeters of mercury. The upper curve is that of arterial blood; the lower, that of venous blood. A is the arterial point; V, the venous point)

The hemoglobin in the red blood cells reaches the lungs in the venous blood that has just left the tissues with its oxygen content reduced to about 13 volumes per cent, or about 62 per cent saturated, and the carbon dioxide tension in this blood is about 47 millimeters. When it reaches the lungs it is spread in a network of small capillaries with an enormous surface, estimated by Zuntz as 90 square meters, and divided from the air in the alveoli only by a thin layer of plasma and the thin flat cells which line the alveoli. These alveoli are filled with air saturated with moisture containing 5 to 6 per cent of $CO_2$, representing a partial pressure of about 40 millimeters, and about 14

per cent oxygen represents a partial pressure of about 100 millimeters. Although the blood is exposed to this alveolar air for a few seconds, the time is sufficient to permit a passage of gases between air and blood which is nearly complete. Thus the hemoglobin leaves the lungs saturated with oxygen to 95 per cent of its total capacity. It then is driven to the tissues where it comes in just as close contact with the cells. These are always withdrawing $O_2$ and combining it with $CO_2$. Therefore their $O_2$ tension is lower than that of the blood and their $CO_2$ tension higher. The process of diffusion of gases is similar to that in the lungs but the directions are reversed.

The carbon dioxide is transported in the blood almost entirely in the form of bicarbonate. This process of absorption and elimination of large amounts of $CO_2$ must be performed without any significant change in the reaction ($_pH$) of the blood. Nature has provided in the phosphates, bicarbonates, hemoglobin and other proteins, substances which make this possible. For a clear and detailed description of this mechanism the reader is referred to the classical article of D. D. Van Slyke (5) on the Carbon Dioxide Carriers of the Blood.

The $CO_2$ can theoretically be present in the blood in four forms, $CO_2$, $H_2CO_3$, $BHCO_3$, and $B_2CO_3$. As a matter of fact, in the blood very little remains as $CO_2$ and a constant proportion of the acid form goes over into $H_2CO_3$. The carbonate ($B_2CO_3$) can hardly exist in the blood in the presence of the usual amounts of $H_2CO_3$, but it goes over into the bicarbonate ($BHCO_3$). If all the $CO_2$ in the blood were in the form of $H_2CO_3$ it would be many hundred times more acid than is compatible with the normal reaction of the blood or with life, and if all of it were in the form of carbonate it would be many hundred times too alkaline. We must therefore consider the small amount of $H_2CO_3$ in the blood, the relatively large amount of $BHCO_3$, and the manner in which the $CO_2$ from the tissues is carried in this form.

Van Slyke speaks of a carbon dioxide carrier, in the physiological sense, as a constituent of the blood which increases the amount of $CO_2$ that may be taken up by arterial blood with a change in reaction equal only to the normal $_pH$ difference between arterial and venous blood. These carriers are the buffer substances, bicarbonates, phosphates, and alkali salts of the proteins, all of them salts of weak acids. They act as reservoirs of alkali, a portion of which may be given up to neutralize carbonic or any other acid that enters the blood.

The chief carrier in this sense is the hemoglobin, which furnishes the alkali to combine with 80 to 95 per cent of the $CO_2$. When the arterial blood comes in contact with the tissues some oxygen is lost, and the relatively strong acid, oxyhemoglobin, is changed by the loss of oxygen to the weaker one, reduced hemoglobin. This process

furnishes most of the available alkali for combination with the acid $CO_2$ which has formed in the tissues. Some of the alkali is furnished by the unchanged oxyhemoglobin, which is itself an efficient buffer, and the remainder is furnished by the phosphate in the cells, the bicarbonate, and the proteins in the plasma.

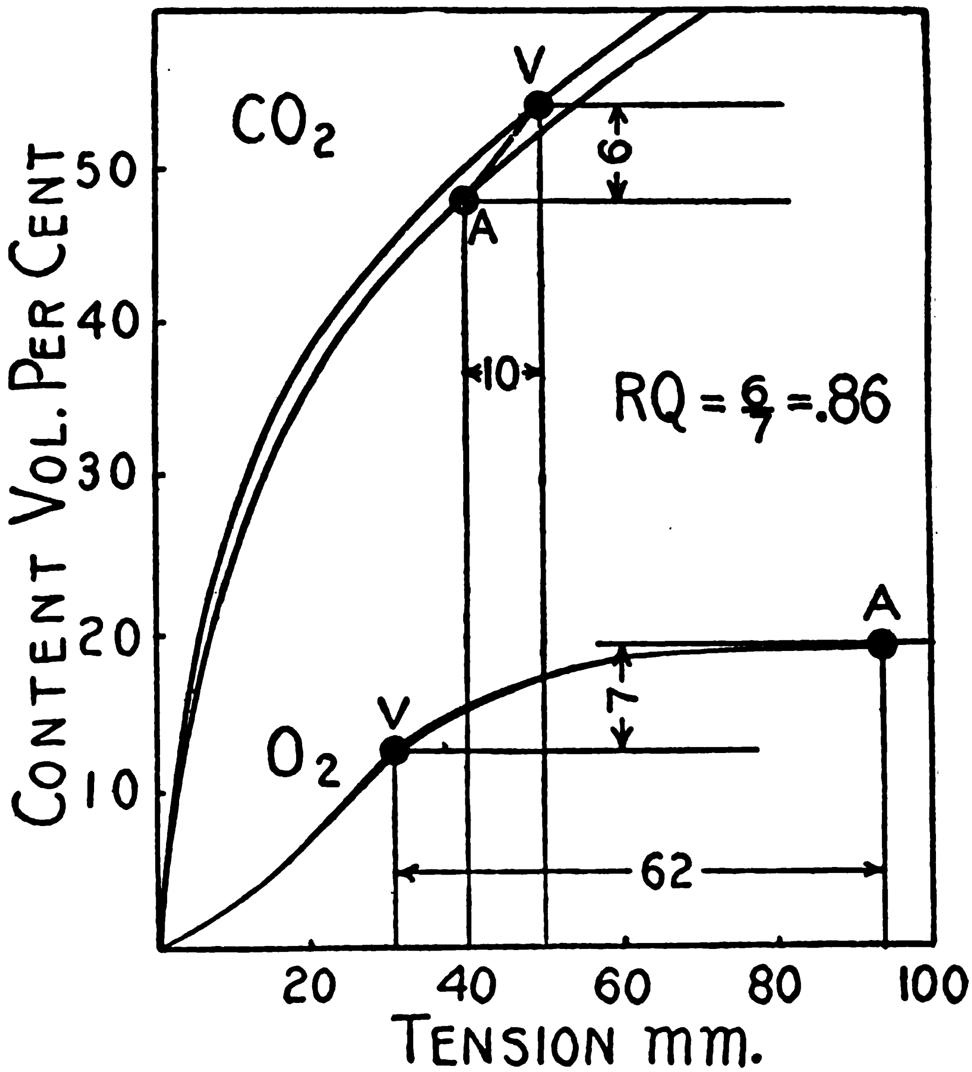


FIG. 2.—(From Means.) The Oxygen and Carbon Dioxide Dissociation Curves shown together

(The ordinate represents the blood content of either gas; the abscissa, the tension. Attention is called to the comparatively short arc of the $CO_2$ curve which is used in vivo, and the comparatively long one of the $O_2$ curve. It will be noted that the tension difference between arterial and venous blood is 62 mm. in the case of $O_2$ and only 10 mm. in the case of $CO_2$. Nevertheless, such are the shapes of the curves that, in this particular instance, there are transported 6 volumes in the case of $CO_2$ and 7 in the case of $O_2$, giving a respiratory quotient (R. Q.) of 0.86)

The hemoglobin in the cells is also able to withdraw Cl from the plasma NaCl, leaving Na to form $NaHCO_3$. Thus the cells help to increase the amount of $CO_2$ that can be held in the plasma.

The curve given in Figure 2 shows the volume per cent of carbon dioxide that will be taken up when human blood is exposed to varying tensions of $CO_2$, expressed in terms of partial pressure in millimeters of mercury. The lower curve is for oxygenated blood, the upper curve for ordinary venous blood. Normally, in alveolar air the partial pressure of $CO_2$ is equal to 40 millimeters. We note that the arterial blood of this subject, as represented by the point A, was in equilibrium with 40 millimeters $CO_2$ and held 48 volumes per cent of this gas; the venous blood held about 54 per cent, being in equilibrium with a partial pressure of 50 millimeters $CO_2$. The total discharge of $CO_2$ in the lungs for a drop of 10 millimeters in partial pressure was 6 volumes per cent. It would have been only about 4 volumes per cent if it were not for the difference in the level of the curves. Thus we see that $CO_2$ and $O_2$ help each other in the loading and unloading.

In the lower part of Figure 2, Means has added the dissociation curve for oxygen on a slightly different scale from that given in Figure 1. We saw that the shift of $CO_2$ tension from 50 to 40 gave off 6 volumes per cent $CO_2$ to the lungs. Under the average condition of normal metabolism 7 volumes per cent of $O_2$ would be absorbed at the same time (R. Q. $\frac{6}{7}=0.86$). With the venous content, V, corresponding to 32 millimeters $O_2$ tension, and the arterial point, A, corresponding to 94 millimeters tension, the necessary 7 volumes per cent $O_2$ will be absorbed.

### The Respiration of the Tissues

All of the living tissues of the body consume oxygen and give off carbon dioxide even at rest. The simplest way to prove this is to kill an animal, make very small slices of its kidney or brain and place them in Ringer's solution in the small Barcroft-Warburg respiration apparatus. If exposed to the proper environmental conditions, they will consume oxygen and give off carbon dioxide for several hours in just about the same proportions as the whole animal before he was killed.

In the living animal, the greater the activity of a certain tissue the greater the gaseous exchange. Thus, a man lying motionless in bed may consume 14 liters (one-half cubic foot) of oxygen an hour, and when performing a " century run " on a bicycle, ten times this amount. The volume of $CO_2$ produced is almost equal to the oxygen consumed. In order to transport the oxygen and carbon dioxide fast enough for the bicycle rider there must be an increased respiration, increased rate of blood flow, and increased dilatation of the capillaries supplying the active parts. The oxygen consumption is almost ex-

actly proportional to the total amount of energy produced in the organism and the carbon dioxide production is roughly proportional also. The total ventilation of the lungs is closely proportional to the amount of these gases. Therefore we realize that the whole crux of the situation regarding the physiology of respiration lies in the total metabolism.

The lowest level of metabolism attained by an individual under normal conditions is the so-called basal metabolism. This varies with the individual and depends upon the size, age, sex, and mode of life. In order to maintain the normal processes of circulation, respiration, and glandular activities the cells must live and breathe. Therefore a man even in complete muscular repose must consume oxygen and give off a certain amount of heat. This heat is measured in terms of calories. The large calory, which is the unit employed, is the amount of heat required to warm 1 liter of water 1° C. (One British thermal unit—B. t. u.—equals 0.252 large calory.) A man of 145 pounds gives off about 69 calories an hour under basal conditions and in doing so consumes about 14.5 liters (0.51 cubic foot) of oxygen and produces about 12.5 liters (0.44 cubic foot) of carbon dioxide. A large man will give off 80 calories; a small man about 50 calories. Children have a relatively higher metabolism for their size; girls and women are about 6 per cent lower than boys and men of the same size. Men of active habits, even when resting, have a slightly higher metabolism than men who lead sedentary lives.

The basal metabolism is always measured in the morning at least 14 hours after the last meal and the subject must be quiet for an hour before the test. These precautions are taken because food has a stimulating effect on the metabolism and a small meal may cause a rise of 5 to 10 per cent; a large meal, 10 to 30 per cent. The heat production does not reach a basal level for an hour after such exertion as walking and for several hours after hard work. Cold requires a greater heat production. Nervous excitement, even that produced by a sudden noise, can cause an increase of 5 to 15 per cent, lasting several minutes. Sleep and prolonged fasting reduce the metabolism.

Under certain conditions of difficult respiration it is necessary to strive to maintain the metabolism at its lowest level. A patient with heart disease or anemia or carbon-monoxide poisoning may not be able to supply his tissues with sufficient oxygen. A group of men entrapped in a submarine may be consuming the oxygen and producing carbon dioxide at a rate which will cause suffocation before rescue can be effected. The obvious things to do are to keep the patients or crew quiet, urging them to sleep as much as possible. They should be kept warm, food given in only small amounts, and

an effort made to avoid unnecessary excitement. Every doctor has learned by experience to follow this course with patients who are seriously ill.

TABLE 1.—*Showing the variation in carbon dioxide production and oxygen consumption of men at different degrees of activity*

| Man weighing 145 pounds | Heat production per hour | $CO_2$ produced per hour | $O_2$ consumed per hour |
|---|---|---|---|
| | *Calories* | *Cubic feet* | *Cubic feet* |
| Motionless in bed | 60 | 0.44 | 0.51 |
| Standing at ease | 76 | .49 | .54 |
| Walking at rate of 3 miles per hour | 230 | 1.48 | 1.65 |
| During "century run" on bicycle | 600 | 4.11 | 4.24 |

TABLE 2.—*Estimated figures for submarine crews*

| Man weighing 160 pounds | Heat production per hour | $CO_2$ produced per hour | $O_2$ consumed per hour |
|---|---|---|---|
| | *Calories* | *Cubic feet* | *Cubic feet* |
| Asleep in bed | 68 | 0.4 | 0.5 |
| Standing at controls, periscope, etc | 82 | .5 | .6 |
| Average during submergence | 123 | .75 | .9 |
| Working on engines, making repairs, etc | 250 | 1.6 | 1.8 |
| Hard work—rigging in hydroplanes, manning hand pumps, etc | 558 | 3.6 | 4.0 |

Tables 1 and 2 (6) give the approximate figures for men at various degrees of activity. They can be applied to men working with gas masks or rescue apparatus, or divers or mountain climbers. Under certain conditions of poor air or rarefied air all work is relatively inefficient, and it requires a greater expenditure of energy than under ordinary circumstances. It is terribly difficult to do hard work in a submarine that has been long submerged without air purification. Balloonists at very high altitudes find themselves too weak to pull the valve cords.

When we come to a study of the various diseases we find that in some the basal metabolism itself is greatly increased. A patient with moderately severe exophthalmic goiter (Graves's disease) will have basal figures 50 per cent above normal. Severe cases give off twice as much heat as normal men of the same size. In addition, their muscular efficiency is greatly impaired. Such a patient, even when resting quietly in bed, needs twice as much oxygen as a normal man. If he tries some form of muscular work, he may require three times as much as the normal man at the same task. The only other disease where the figures approach those found in exophthalmic goiter is leukemia, but in some of the other anemias there is a moderate rise in the basal metabolism. Fever causes a rise in oxygen consumption, and a man with a temperature of 104° F. needs 40 per cent more oxygen than when his temperature is normal. Dyspneic patients

with heart disease or nephritis require more oxygen than normal men, largely on account of the increased muscular exertion of breathing. It is interesting to note that the metabolism is not increased by propping up such a patient in bed with pillows, and, as we shall see later, this position makes breathing easier.

When the tissues demand an extra supply of oxygen and removal of carbon dioxide the organism responds with an increased heart rate and probably with an increased volume output of the heart at each systole. Krogh has shown that under ordinary conditions a very large proportion of the capillaries are closed most of the time, and as the activity of the part increases more and more of these open to permit a freer blood flow where it is needed. The increasing percentage of $CO_2$ in the blood seems to be the chief cause of this dilatation of the capillaries.

We have already seen that the oxygen in the arterial blood is normally saturated to 95 per cent of its total oxygen capacity and it is obvious that the blood can not significantly increase the amount of oxygen that it carries per unit of volume. As a matter of fact, the arterial blood in exercise is not quite so highly saturated with oxygen as in resting conditions, probably on account of the swift flow through the lungs. The venous blood, however, contains less oxygen than normal, having been deprived of more oxygen in the tissues. In a similar fashion the $CO_2$ of the venous blood is increased. Now the $CO_2$, acting as a weak acid, is a stimulant to the respiratory center and thus causes an increase in the rate and depth of respiration. This, in turn, leads to a better ventilation of the alveoli and keeps the alveolar air at almost the same composition as during rest.

## The External Respiration

It is necessary at this point to describe more fully the external respiration, or manner in which the air enters the lungs. The right and left pleural cavities are divided from each other by the mediastinum, which is normally always in the mid line but is freely movable from side to side so that it can be pushed over when the pressure on one side is greater than on the other. There is no opening in this mediastinum in man, but apparently in some dogs there is such an opening which will, in case of puncture wounds of the chest wall, permit the air to pass from one side to the other. Normally there is a slight negative pressure, about −6 millimeters of mercury, in the pleural cavities, and, since the insides of the lungs communicate with the open air, the atmospheric pressure expands the easily distensible lungs until they completely fill every portion of the pleural cavity. During the act of inspiration the negative pressure is increased and in forced inspiration it may reach −20 millimeters. Inspiration is

brought about partly by an inward and outward movement of the ribs lifting the chest wall, increasing the distance between sternum and spine as well as the breadth of the chest. Even more important than the action of the ribs is that of the diaphragm, a broad, flat muscle attached to the walls of the thorax and abdomen and arching upward in a dome, with its apex in the lower thorax. To be more exact, there are really two domes, one on either side, with a central portion attached to the pericardium, which moves but little in ordinary respiration. As the diaphragm contracts these domes flatten out and increase the internal capacity of the pleural cavities with an action that accomplishes the same result as the withdrawal of the piston of an air pump.

It is extremely important to realize that certain parts of the thoracic wall hardly expand at all. These are the region of the first rib, the spine, and the mediastinum. The greatest expansion comes at the lower and outer portions of the thorax, and it is the portion of the lung in this region that dilates most and gets the greatest share of fresh air. The upper and inner portions of the lung receive their pull after it has been transmitted from the lower and outer portions. The action is not unlike that of a concertina, where the player holds the left hand steady and pulls in and out with the right hand. When he plays quietly it is only the right portion of the bellows that does much pumping. When he plays more vigorously the left portion of the bellows is expanded by the pull. In the lungs the blood flows more freely through the parts that are expanding, but there is, of course, a large amount of blood circulating through the parts that are less freely ventilated. When the breathing becomes rapid and very shallow, only a portion of the circulating blood is fully oxygenated. This is mixed with poorly oxygenated blood from the portions that are incompletely ventilated. In certain stages of lobar pneumonia there may be portions of the lungs where the alveoli are filled with exudate, but the blood vessels are still patent. In such a case, some of the blood is not oxygenated at all, and this mingles with the oxygenated blood as it returns to the heart. These are extreme cases, but even with normal respiration some blood passes through portions of the lungs where the alveolar air contains more $CO_2$ and less $O_2$ than the average. In obtaining a sample of alveolar air, the last portions of a forcible expiration, we may or may not obtain a mixture that is representative of the functionating alveoli.

Expiration is largely a matter of elastic recoil where the expansive pull of diaphragm and intercostal muscles have been relaxed. Part of the recoil comes from the lungs themselves, which have been pulled beyond their resting position, part comes from the pressure upward of the abdominal contents. There may also be some muscular action

in quiet expiration. With full expiration there is contraction of the muscles of the thoracic and abdominal walls sufficiently strong to raise a column of mercury 100 millimeters or to make a loud noise on a musical instrument.

When a man is swimming the pressure of the water hinders inspiration and aids expiration. When he is under pressure in a diving lock there is no abnormal difference in pressure between the inside and outside of the chest cavity.

(To be continued.)

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# FRACTURES

By G. F. Cottle, Commander, Medical Corps, United States Navy

### Incidence and Damage

All forms of appendicitis, acute and chronic, added to all types of hernia, occasioned a total of 1,705 admissions to the sick list of the Navy during the year 1925; 2.77 per cent of the total admissions from all causes for the year. Fractures, simple, near joints, and compound resulted in 1,551 admissions; 2.52 per cent of the total admissions from disease and injury for that same year. Figures are uninteresting, but these seem to indicate that so far as admissions to the sick list of the Navy are concerned fractures play a very considerable rôle. If we add up the sick days caused by fractures for the year 1925 we get the figure 74,654 days, which means 6.20 per cent of the sick-day damage that year. Damage from fracture cases is best measured in terms of ultimate results, such as the degree of deformity, malfunction, malunion, lessened value of the individual to himself or to his environment. As an index of this sort of damage in the Navy let us look at the cases discharged for physical reasons as the result of fractures in the year 1925. These amounted to 63 in number, approximately 40 per cent of the total invalided for injuries. (See table.)

*Invalided from the service—1925*

| Location of fracture | Compound | Simple | Total |
|---|---|---|---|
| Multiple | 2 | 0 | 2 |
| Spine | 0 | 4 | 4 |
| Skull | 2 | 1 | 3 |
| Pelvis | 0 | 2 | 2 |
| Femur | 0 | 5 | 5 |
| Humerus | 1 | 1 | 2 |
| Tibia and fibula | 6 | 15 | 21 |
| Radius and ulna | 1 | 4 | 5 |
| Ankle | 0 | 2 | 2 |
| Os calsis | 1 | 3 | 4 |
| Bones of hand | 5 | 4 | 9 |
| Maxilla | 2 | 1 | 3 |
| Rib | 0 | 1 | 1 |
| Total | 20 | 43 | 63 |

*Fracture deaths—1925*

| Location | Simple | Compound | Total |
|---|---|---|---|
| Spine | 2 | 0 | 2 |
| Skull | 9 | 13 | 22 |
| Femur | 1 | 1 | 2 |

### Fracture Care in Civil Life

The World War brought very wide experience in the care of fractures to many surgeons. Since the war, in America, and especially in Europe, the crippling of individuals which resulted from badly treated or neglected fractures has been brought home to many persons and has caused doctors everywhere to try for better results. Methods and results previously accepted are now challenged as not being good enough. Liability insurance, laws requiring employers to pay their employees for industrial accidents, the X ray in the hands of the jury, the increasing complexity of the struggle for existence, these and many other factors have made the fracture patient important, and the medical profession is setting up for itself a higher ideal of treatment each year. For several years the American College of Surgeons has maintained a committee on the treatment of fractures, and this committee has formulated a minimum set of requirements for such treatment in hospitals. This has been adopted by the college and urged by its hospital standardization program as follows:

(A) That all general hospitals be equipped to care for fractures; that the minimum equipment for the transportation and the emergency treatment of fractures be the following or its equivalent:

1. Thomas upper-extremity splint.
2. Thomas lower-extremity splint, with traction straps, slings, and buckles.
3. Hodgen splints.
4. Coaptation splints, assorted sizes.
5. Cabot wire splints.

6. Straight pieces of wood (of assorted length and thickness) for splints.
7. Plaster of paris bandages.
8. Some form of overhead frame or suspension.
9. Suitable X-ray apparatus, including a portable machine, if practicable.

(B) That it is highly desirable that one individual surgeon be responsible for the supervision of the care of fractures in each hospital service.

(C) That special record sheets be used for fracture cases.

### The Naval Surgeon and Fractures

With 784 naval surgeons and a total of 1,551 fractures throughout the service in a year, the individual surgeon's interest in this subject must of necessity tend to be very slight. There must be many who will not have a fracture to treat in an entire year, perhaps longer. It is impossible to expect that every naval surgeon can acquire and maintain an expert working knowledge of the treatment of all fractures and keep himself informed on the recent literature of this specialty of surgery. Yet how important it is for the individual with a broken bone to find himself in the hands of a doctor who is especially prepared to treat that bone in such a way as to restore him to a state of industrial efficiency with a minimum of malfunction. On board small vessels, at certain naval stations, and even on larger vessels and at navy yards, the X ray is either not present or inadequate in type to give a proper picture of all kinds of fractured bones. There may be doctors to-day who can get good results in reduction and treatment of all types of fractures without the aid of the X ray, but the number of such unusual men is small and getting smaller each year. This situation means that, whenever at all possible, every patient with a fractured bone should be transported to a medical unit where first class X-ray apparatus and service is available. Naval surgeons, except at a few isolated stations and when actually cruising at sea, can and should transfer fracture cases to a naval hospital, hospital ship, or some other medical activity, naval or civilian, where at least the minimum requirements laid down by the American College of Surgeons are to be had. Minimum standards for the naval surgeon and naval environment outside the hospital can be determined, and the following is a suggestion along this line:

For the surgeon:

1. Knowledge of first aid care for fractures, simple and compound.
2. Knowledge of the best methods of first-aid splinting to facilitate early and safe transportation of the fractured.

For the small ship or station:

1. The Thomas upper extremity splint.
2. The Thomas lower extremity splint.
3. Access to carpenter with a knowledge of the length, width, and thickness of wooden splints that may be needed.
4. Plaster of paris bandages.
5. The Navy splint case (when allowed).

For the first-aid treatment of fractures there are a few essential underlying principles. The approach to a patient with a freshly fractured bone should be intelligent, guided by a knowledge of the pathology of fracture, gentle, and with a definite intention to lessen and not to increase the degree of trauma and insult to the tissues already caused by the injury. To try to get crepitus, therefore, is generally bad practice. It is often unnecessary for diagnosis and always injurious to the patient. "Splint him where he lies" (see plates), a slogan so vitally necessary in fracture of the femur, is one that may well be applied in principle to all fractures. The general appearance of the injured man will at a glance give one the clew to the degree of shock present, and at times, especially in multiple fracture and in those of the femur and pelvis, the treatment of shock may be more vital than that of the fracture during the first few hours or even in some cases days. A very gentle cutting of clothing, without the movements necessary for its removal, will show whether the fracture is compound or simple, and "Seal the opening in the skin with sterile dressings immediately" is a dictum of the same vital significance for the compound fracture as is the "Splint him where he lies" for the fracture of the femur. Emergency splinting should be taught to all Hospital Corps men on independent duty, and such teaching will bear good fruit if the upper and lower extremity Thomas splints are available. Every naval surgeon and every Hospital Corps man on independent duty should be familiar with this splint, with its method of application, and with the simple method of obtaining sufficient traction on a fractured bone to permit early, safe transportation. A valuable emergency splint for ankle fractures is the pillow splint; a simple pillow wrapped about the foot and perhaps reinforced by a wooden splint on the outside. Fractures of the upper extremity, except those of the shaft of the humerus, afford no special first-aid problem. The patient generally is able to hold the fractured extremity reasonably well with the other, if uninjured, hand. Fractures of the skull require the least possible transportation. Intelligent neurological observation is more important than splinting. For fractures of the spine and pelvis, the Stokes stretcher affords an excellent first-aid splint, and the need for careful, expert medical observation of the function of the cord, the bladder, and urethra makes early transportation to a well-equipped medical unit a matter of vital importance to these patients.

### The Newer Treatment of Fractures

In America, the French enthusiasm for early ambulant treatment of fractures has not found everywhere an exact parallel among all surgeons, but the use of the caliper walking splint as a protection in

the later weeks of convalescence from femur and leg fractures has been stimulated by the French advocacy of early ambulant methods of treatment. Immobilization of the fracture has been carried so far by many that it has been forgotten how serious may be the result of too long immobilization of near-by joints and tendons. It has gradually been realized that something less than the ideal of perfect X-ray replacement of bone fragments may in certain cases be best, if by such sacrifice of that ideal a better function of the limb may result. It has been found that immobilization of the fracture itself may be practiced and still allow early mobilization of muscles, tendons, and near-by joints. Voluntary motion is encouraged at an earlier date than was formerly the custom. Passive movements are discouraged. Carefully supervised use, short of weight bearing, combined with early judicious massage and, at times, diathermy, will increase callous formation and lessen the duration of delayed union, if threatened. A united fracture in an extremity handicapped by fibrosis of muscle or nerve paralysis is a poor substitute for a once useful leg or arm. Just as muscle or bone will atrophy from disuse, so will a too long prolonged convalescence result in a lessening of the patient's desire and ability to return to a gainful occupation. The reeducation of a fracture case to work is often a vital and sometimes neglected therapeutic necessity. Intelligent vocational therapy during convalescence, carefully directed medical exercises, the aid of medical social-service direction may be necessary before the patient with a fractured bone may safely be returned to full industrial independence and usefulness to himself and the community.

Traction in Thomas or Hodgen or other splints, with the aid of suspension by ropes and pulleys from overhead frames, "The Balkan Frame," and others, is now considered essential in many cases of humerus and femur fractures and not infrequently for those of the tibia and fibula and radius and ulna. The ice tongs, the Steinmann pin, and other means of direct skeletal traction should be used when adhesive-to-skin traction fails. Manipulation, if need be, under ether; coaptation of broken fragment to broken fragment; restoration of alignment of the extremity; prevention of rotation and of bowing after reduction; check by the X ray, especially after reduction and during convalescence; as much immobilization as need be of the fragments, combined with as much mobilization of the rest of the patient as is compatible with union; early massage; early use, within the limits of safety for the age and condition of the particular patient and the particular fracture; an early but guided return to a gainful occupation; these constitute the essentials of treatment, and a naval surgeon in a naval hospital charged with this responsibility and this duty has a valuable place in the organization. Its possibilities may be used for the benefit of himself, the Navy, and, above all, the patient. The

American Medical Association has published an "Outline of the treatment of fractures," originally printed in the Archives of Surgery, January, 1923, volume 6, pages 172–194, and any surgeon charged with the care of fractures would do well to have this syllabus for ready reference. In its few pages are condensed the essentials for treatment of all fractures of the body, as agreed upon in 1922 by a group of surgeons selected for their experience and eminence in this field.

### The Operative Treatment of Fractures

*Compound fractures* are operative, at least so far as operation can go toward a proper degree of surgical cleanliness, to prevent serious and long-drawn-out infection. The exact nature of the operation to be performed varies. If the compounding is merely due to a relatively clean projection of a spicule from within, very little more than cleansing is needed. If tissues are contaminated with dirt, clothing, etc., this surgical cleansing may have to be carried even to a "debridement" of the wound. Internal splinting with metal or bone fixation is generally contraindicated in these cases until the menace or the presence of infection has been thoroughly combated by Dakinization or other methods of wound sterilization calculated to bring about a state of asepsis. Traction methods in these cases are of the greatest help in treatment, to prevent deformity during the period when frequent dressings are needed.

In *closed or simple fractures* operation may be needed, but as a general rule the better the various methods of closed reduction the fewer will be the cases requiring open operation. The safety of the patient requires a special technique, trained assistants, gentle handling, and a special knowledge on the part of the surgeon who is to make the surgical attack. While it is true that the occasional operator may often be successful in an operation on a simple fracture without all these aids, such operations are not devoid of danger to the patient far exceeding the probable benefits sought. If the operator, then, has justified confidence in his special knowledge, in his operating environment and operation team, he should operate in those cases of simple fracture for which experience has taught the value. Of these may be listed:

Fracture of the patella with separation.

Fracture of the olecranon with separation.

Fracture of the os calsis head with separation.

Fracture of the shaft of the femur which has resisted reduction by traction and manipulation.

Fracture of both bones of the forearm which have resisted efforts at replacement.

Fracture of several metacarpals or metatarsals with great irreducible overriding.

## *Fracture records* *

GENERAL RESULTS

| | Good | Moderate | Bad |
|---|---|---|---|
| Anatomical.......................... | ............ | ............ | ............ |
| Functional.......................... | ............ | ............ | ............ |

1. Bone ........................ 2. Site—Neck......Upper......Middle......Lower 3d......Condyle ......Involving joint................................................................................
................................................................................................

3. Name.............................. 4. Sex—M.... ...F........ 5. Age........ 6. Occupation ....................
7. Time fracture occurred—Date.......... Hour.......... 8. Hospital entered—Date.............. Hour ............
9. First treatment—Date..................Hour.......... 10. Cause of fracture..................
11. Kind of fracture—Oblique......Transverse......Spiral......Impacted......Comminuted.......... Simple......Compound......Greenstick......Subperiosteal..............................
12. Was there serious injury to soft parts—Skin—Yes....No.. Muscles—Yes....No.. Vessels—Yes.... No.. Nerves—Yes....No..
13. Reduction: How many hours elapsed after accident before reduction? ..........................
14. Was anatomical reposition of fragments obtained? Yes....No..................................
15. Anesthetic used: Yes......No...... Ether.................. Gas..............................
16. Fixation: Closed method.
    Position: Hyperflexion......full supination ....abduction....
    Splints......................................
    Plaster of Paris.............................
    Traction: Buck's......Thomas......Hodgen......
    Balkan frame......Steinmann........
    Amount of weight used......................
17. Fixation: Open method.
    Was nonoperative treatment tried first......
    How long after injury was operation performed.........................................
    Was open reduction alone performed........
    What form of internal fixation used—Steel plates......Wire........Nails........Screws ....Bone transplants or implants..........
    Was it later necessary to remove fixation materials? Yes......No...... Date........
18. Shortening at first examination..................cm. When all apparatus removed.............. cm. Date...............When discharged from hospital..........cm. Date.......... At last observation.............cm. Date............
19. X-Ray used—Yes...... No...... First finding—Date.....................day before reduction ...............day after reduction.

| Plate No. | Fragments displaced | Not | Slightly | Markedly | Over-riding | Rotation | Angulation |
|---|---|---|---|---|---|---|---|
| .......... | Before reduction, date.. | ....... | .......... | .......... | .......... | .......... | .......... |
| .......... | After reduction, date... | ....... | .......... | .......... | .......... | .......... | .......... |
| .......... | After union, date...... | ....... | .......... | .......... | .......... | .......... | .......... |

20. How long confined in bed...................... How long in hopsital.........................
21. How long did patient use crutches.............. Cane........................................
22. Results: Final examinations made........weeks....... months after injury. Union: Bony....... Fibrous..........Nonunion..........
23. Disability: Absent......Partial......Complete......Estimated by..........Shortening........... Angulation......Swelling of soft parts.......... Pain......Nerve involvement......Interference with joint function......Endurance ..................................................
24. Mortality: Main cause of death......Age of patient......Shock......Hemorrhage......Other injuries ......Sepsis......Exhaustion......................
25. Duration of absence from work..............weeks..........months..........................
26. Is patient fully able to take his former job.............................................
27. Present wage-earning capacity compared with former........................................
28. Compensation under insurance, legislative act or legal process obtained—Yes........No........ Expected—Yes........No........

*Compiled and recommended by the American Surgical Association especially for use in industrial hospitals.

Form C. CHART 1

Very rarely fractures of the shaft of the humerus or the tibia in which traction and coaptation have failed to bring about and retain a reasonable degree of bone fragment to bone fragment; certain fractures near the surgical neck of the humerus, the head of the radius, and of the carpal scaphoid.

For *malunion*, uncorrected deformity causing real functional disability, and for *nonunion*, operation is indicated and not infrequently practiced in the naval hospital, especially for the Veterans' Bureau patient, but rarely for members of the naval personnel. Here the opinions as to the value of various methods of operation are so many

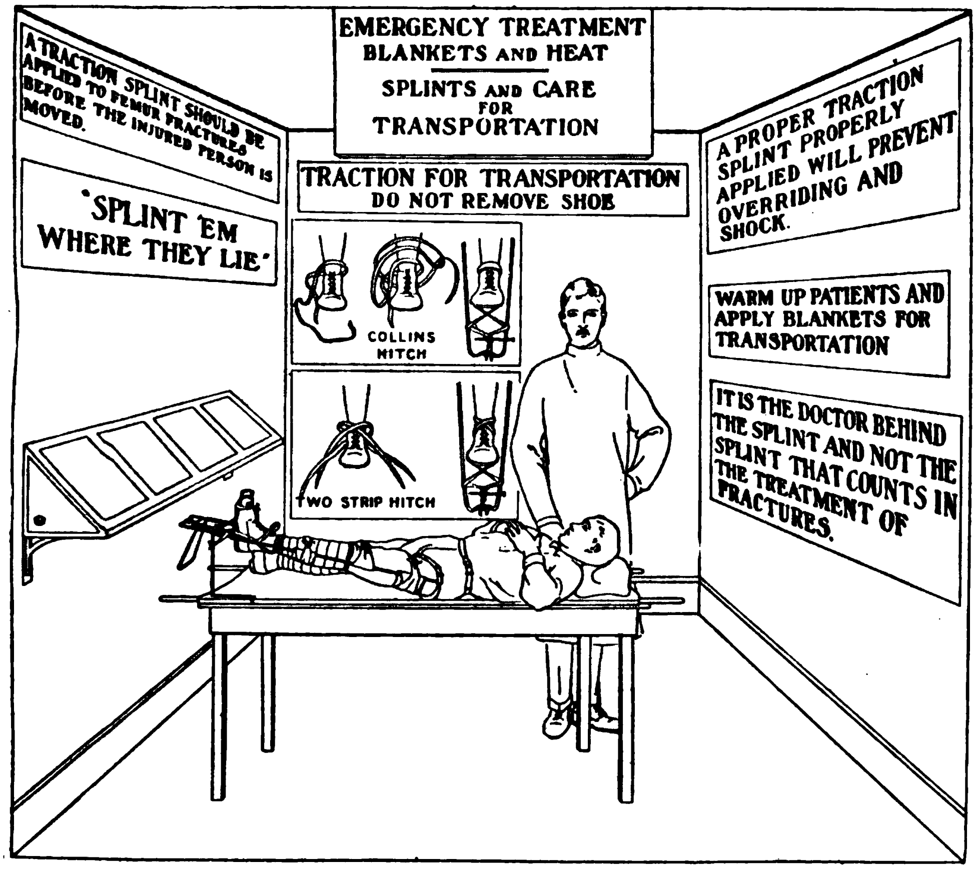


FIG. 1.—Fracture of Shaft of Femur

(From Fracture Exhibit, American Medical Association. By permission)

and so apparently divergent that it would be futile in the scope of this article to do more than state that in this class of cases operation offers often the only hope of an approximate return to useful function. The better the first-aid treatment, the better the management of freshly acquired fractures, the smaller this group of cases become.

### FRACTURES ABOARD THE U. S. S. "RELIEF"

During the 13-month period October, 1925, to November, 1926, 1 month of which period was spent in overhaul at the navy yard, there were received and discharged from treatment aboard the *Relief*

150 cases of fractures. Six of these were operated upon—4 aboard ship and 2 at the naval hospital, Mare Island, Calif. Two were invalided from the service; 2 died; and all the remainder returned to full duty in the Navy. (See table.)

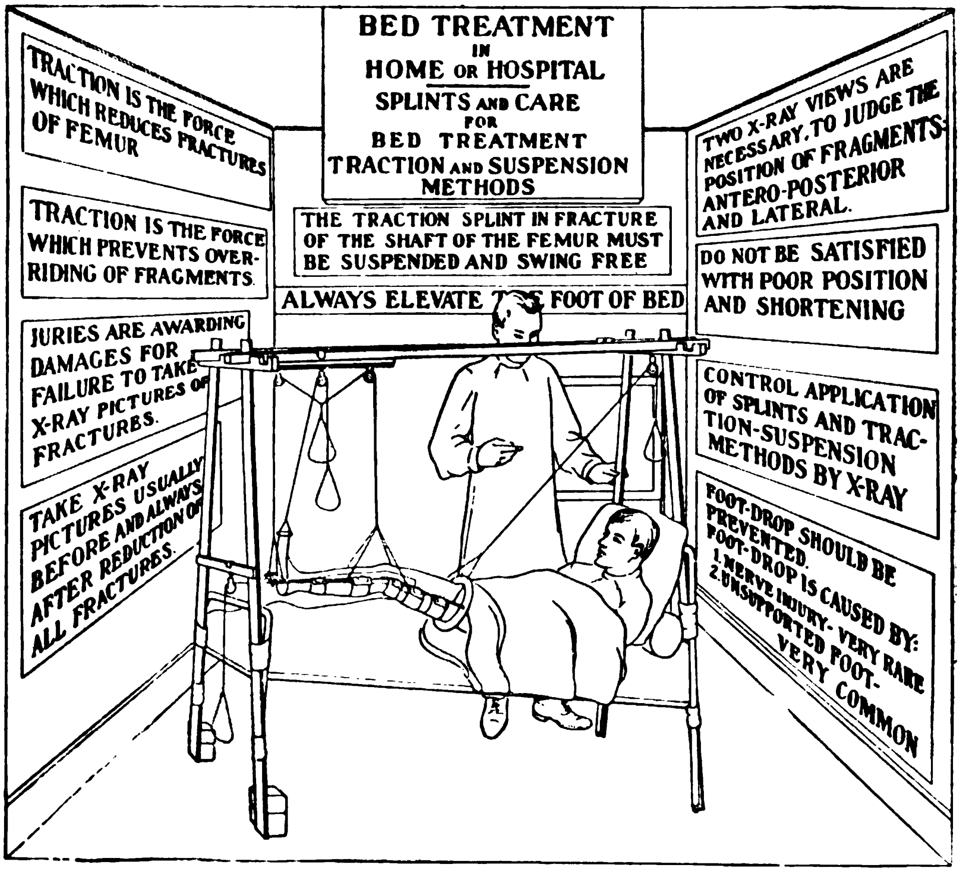


FIG. 2.—Fracture of Shaft of Femur

(From Fracture Exhibit, American Medical Association. By permission)

*Relief cases—150*

| Location of fracture | Number | Operations | Deaths | Invalided from service |
|---|---|---|---|---|
| Spine | 2 | 0 | 0 | 0 |
| Skull | 5 | 0 | 2 | 0 |
| Pelvis | 1 | 0 | 0 | 0 |
| Femur | 3 | 0 | 0 | 0 |
| Patella | 2 | 2 | 0 | 0 |
| Humerus | 2 | 0 | 0 | 0 |
| Tibia and fibula | 35 | 4 | 0 | 2 |
| Radius and ulna | 10 | 0 | 0 | 0 |
| Bones of the hand and foot | 32 | 0 | 0 | 0 |
| Tarsals and carpals | 5 | 0 | 0 | 0 |
| Maxilla | 29 | 0 | 0 | 0 |
| Malar and nasal | 8 | 0 | 0 | 0 |
| Scapula | 4 | 0 | 0 | 0 |
| Clavicle | 9 | 0 | 0 | 0 |
| Rib | 3 | 0 | 0 | 0 |
| | 150 | 6 | 2 | 2 |

The care of these cases has left the staff of the *Relief* with certain impressions, some of which are herein mentioned:

Fractures of the lower jaw belong to the dental surgeon. The uniformly almost perfect results obtained in these 29 cases by the dentist contrast very sharply with the poor results formerly obtained by the general surgeon, who depended on the Barton bandage and other more complicated, and generally insufficient, extradental appliances.

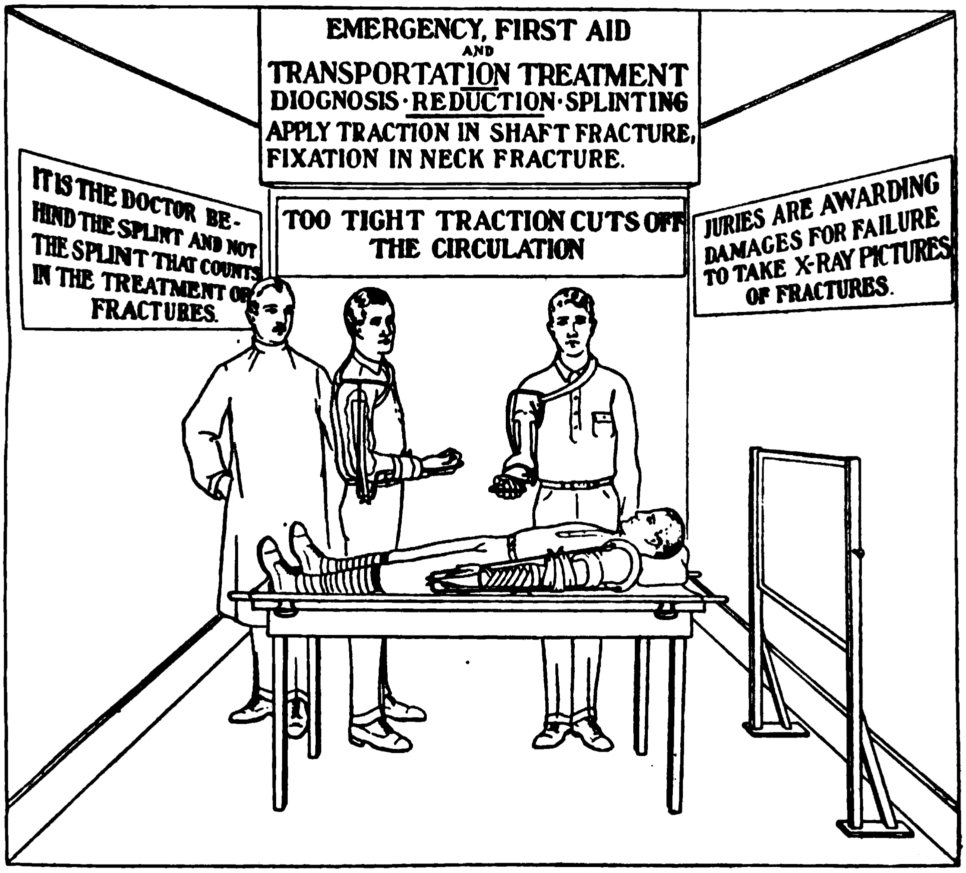


FIG. 8.—Fracture of Humerus

(From Fracture Exhibit, American Medical Association. By permission)

Operation is very seldom indicated for simple fractures in the Navy.

Efficient first-aid care, early reduction, elevation of the fractured part for the first few days, early mobilization of the extremity without threatening the immobilization of the fragments, early massage, early active motion, vocational reeducation to the sea-going environment, will reduce the damage from fractures to the individual and to the service.

Removable plaster splints of the Stimson type are of great service in treatment of fractures of the tibia and fibula, including fractures

about the ankle joint. They permit early massage, active motion, ambulant care, and early return to use.

A knowledge of the use of traction with the help of suspension in the Balkan frame is an essential in the care of most fractures of the femur and the humerus and is often of value for those of the radius and ulna and tibia and fibula.

Skeletal traction with ice tongs or Steinmann pin will lessen the need for open operations.

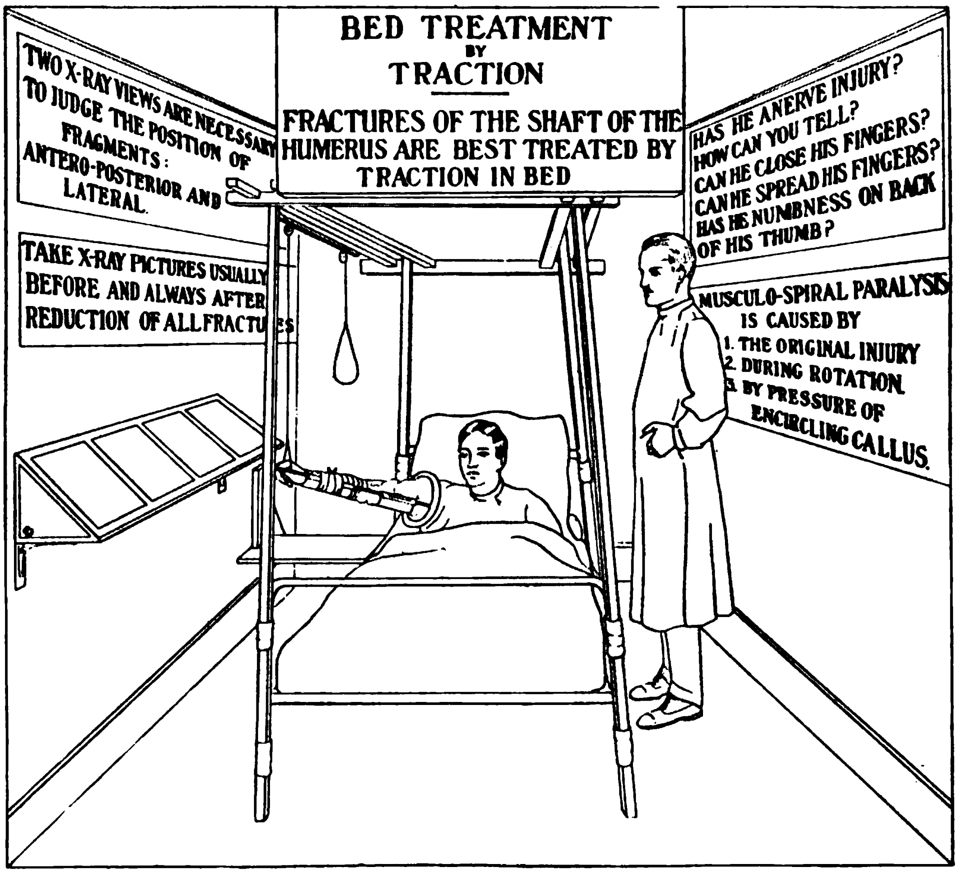


Fig. 4.—Fracture of Humerus
(From Fracture Exhibit, American Medical Association. By permission)

A portable X-ray machine is essential for the proper care of fractures of the shaft of the femur.

Fractures of the skull are not a fracture problem. Here it is the degree of injury to the brain and threat of infection of its meninges with which we are concerned.

### Fractures in the Naval Hospitals and Hospital Ships

All our larger hospitals have been found to meet the minimum standard for class A hospitals as laid down by the American College of Surgeons, but are they all meeting the requirements of that program for the treatment of fractures? Specifically, do they all require

that one individual surgeon be responsible for the supervision of the care of fractures? Do they all use special record sheets so earnestly recommended by the college as a means to judge of the efficiency of that individual surgeon's care of fractures? Did 63 cases of fracture invalided from the service in 1925 represent the irreducible minimum of permanent damage for that group of 1,551 fractures? Can we in the future do better than this? Have we a " follow up " system in the Navy that will act as a check upon the care this type of patient is receiving?

### Conclusion

1. Fractures cause approximately 2 per cent of all admissions to the sick list and 6 per cent of all the sick day damage in the Navy. Forty per cent of the persons invalided from the service for injury in 1925 were so invalided because of fracture.

2. The requirements of the American College of Surgeons for the care of fractures should be strictly carried out in the naval hospital and aboard hospital ships. Perhaps the Bureau of Medicine and Surgery should prepare and issue for use the special form for recording the clinical care of fractures, advocated by the American College of Surgeons. (See chart 1.)

3. All naval medical officers and all Hospital Corps men on independent duty should be familiar with the use of the Thomas splint as a first-aid and transportation splint.

4. The Thomas lower-extremity splint should be requisitioned by all medical activities and its distribution throughout the service so maintained that a fracture of the femur need not be subjected to transportation without its aid and protection.

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## PRACTICAL THERAPY IN DERMATOLOGY

By Richard L. Sutton, Assistant Surgeon, United States Navy (retired)

An editorial writer in the Journal of the American Medical Association recently said: " Enthusiasm for the new is not infrequently permitted to obscure the merits of that which has preceded it. A new method of treatment tends to displace its predecessors for a time until, not infrequently, the glamor of the supposed advantages are dimmed; whereupon the older tried procedures are occasionally restored to some of their former vogue. New drugs are acclaimed loudly until their limitations are discovered, and they find their proper place in the physician's armamentarium."

In no division of medicine is this truer than in dermatology. Possibly it is a result of the highly specialized character of this particular branch, but more probably it is due to the fact that almost any medical man, neophyte or veteran, can potter with a diseased skin and safely get away with it.

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One of the most skilled and successful dermatologists that I have ever known was the late Phineas Abraham, of London. A confrère of Sir Jonathan Hutchinson's, at old Blackfriars, thoroughly versed in cutaneous pathology and physiology, as well as in cutaneous therapy, Abraham could secure better results with less medicine than any other man that I have ever met. He held that a few simple and practicable remedies, with the exact action of which the prescriber was thoroughly familiar, were better than a miscellaneous host of comparatively strange therapeutic agents.

Complicated as the field of dermatology is, I believe that a physician of experience and judgment could successfully combat the majority of cutaneous disorders with a fairly abbreviated materia medica. Less than a score, at the most, and possibly less than a dozen, different drugs.

In the treatment of cutaneous cancer, for many years we relied principally upon the X ray. During the past decade and a half, however, in my own practice, radium has taken the place of X rays, and in the past five years the electro-cautery has gradually supplanted radium. To-day if I were compelled to choose between the two (which fortunately I am not, for in some instances radium is invaluable) I should take the cautery. And the cautery was a well recognized therapeutic agent when I first graduated, nearly 30 years ago.

For all practical purposes I consider the results secured by its use far superior to those following electro-coagulation. It is simple, reliable, inexpensive, and, above all, efficient and dependable. In combatting some of the less serious disorders, simplicity also is an important factor.

During the past 25 years the remedies that I have employed in the treatment of psoriasis are legion. In the end, I have sifted them down to four. And I no longer dread to see an extensive case of psoriasis brought into my office. Internally I have learned to depend upon foreign proteins and, to a lesser degree, arsenic; externally, on chrysarobin and ammoniated mercury. Chrysarobin is the most valuable of all.

It is prescribed in a vaseline mixture, in the proportion of one to five. At first glance, 20 per cent may appear rather strong, but in an experience covering several hundreds of cases I have never seen any ill effects following its use. Of course it can not be applied to the scalp and face because of its staining qualities and its liability to cause conjunctivitis, but when employed on the trunk and limbs, best with a small, stiff bristle brush, night and morning, the result

is little short of marvelous. One week of hospitalization generally is sufficient. The mercurial, in a mixture consisting of salicylic acid (10 parts), ammoniated mercury (5 parts), and vaseline (85 parts), is used on the face and scalp, and later, if need be, on the trunk and limbs. As a rule, at the end of a week it is best carefully to cleanse the skin with soap and water, and if much inflamed apply zinc oxide ointment for a few days. Any persistent lesions can then be treated with the ammoniated mercury ointment after the patient leaves the hospital. Care must be taken to bandage the patient's eyes at night to protect them from the chrysarobin.

Of the various foreign proteins, I have found colon vaccine best (in doses of from 100,000,000 upward, always subcutaneously, never intravenously), although some of the milk preparations are reliable and dependable.

Protein shock appears to lessen the resistance of the cutaneous lesions, and render them more susceptible to the action of chrysarobin and similar remedies.

Not until the patient is rid of the eruption is arsenic prescribed, and even then its action is carefully watched. It is best given by mouth, in the form of Liquor potassii arsenitis, and doses of more than five or six drops, well diluted, and on a full stomach, seldom are necessary. Care must be exercised to prevent the patient from continuing the arsenic over long periods of time. Arsenical keratoses are easily acquired and hard to get rid of.

In the public services, acne vulgaris frequently proves a source of humiliation to otherwise clean-looking and well-groomed young men. While age is an important factor, there is often present a well-defined seborrhœa which aggravates the more unsightly disorder. In fact, as Whitfield has pointed out, acne is particularly prone to develop on a "seborrhœal" base.

The eradication of any concomitant focal infection that may be present, and particularly infections of the tonsils and teeth, is exceedingly important. Diet likewise plays a prominent part as a subsidiary causative factor. While blood sugar estimations should be made, I have not found excessive amounts of sugar as significant a factor as I had at first hoped.

Dietetic restrictions are important. I consider chocolate the most harmful of all. In addition to chocolate, nuts, excessive amounts of coffee, ham, sausage, pie, pancakes and waffles, and, occasionally, oatmeal, aggravate the disorder.

Locally, recourse may be had to lotions or salves, together with a mechanical keratolytic, as Peet's pumice stone soap. Of the various lotions that have been suggested, one which contains zinc sulphate

(2 parts), sulphuretted potash (4 parts), precipitated sulphur (4 parts), and rose water (190 parts), probably is the most popular.

The ointments vary in composition. I consider Hazen's formula best. It consists of salicylic acid (4 parts), resorcin (4 parts), and rose-water ointment (22 parts).

At night the face should be washed with water as hot as can be borne, to be followed immediately by ice water, dried, and the lotion or salve applied. In the morning, warm water and soap are used, to be followed by cold water. When the skin becomes hard, tense, and dry, cold cream only is applied three times a day. Afterwards the medication may be repeated. In the hands of an expert, X-ray therapy sometimes gives excellent results, but unless the operator is skillful, and thoroughly conversant with the apparatus, it is wiser to let the other man take the chance. I have seen some extremely unfortunate results following the use of the X rays.

A word regarding the treatment of epidermophytosis of the hands and feet may not come amiss at this time. The condition is a very common one, and as a rule proves stubborn and resistant to medication. In the acute types, it is best to incise the vesicles or pustules and swab out the cavities with 10 per cent silver nitrate solution. Following this, cotton packs, moistened with a saturated aqueous solution of aluminum acetate, are to be applied until the skin becomes dry and wrinkled. The toes, if involved, should be separated by pledgets of cotton. Kingery and his associates found that even weak solutions of thymol were the best parasiticides in infections of this kind. Solutions gave better results than ointments. Consequently, a 1 per cent solution of thymol in alcohol (80 parts) and water (19 parts) may be frequently applied.

In addition to the thymol, I have found an ointment which was first recommended to me by Schalek, and which consists of salicylic acid (1 part), precipitated sulphur (8 parts), and zinc paste—equal parts of zinc oxide, starch, and vaseline, thoroughly mixed (21 parts)—of very great value. It is applied at night for six or seven days, then discontinued, to be followed by a simple zinc oxide ointment. During the day, Anderson's powder, which consists of camphor (4 parts), zinc stearate and starch (of each 48 parts) may be used.

Soap and water are to be avoided. For cleansing the inflamed areas nothing is better than Pusey's lotion. It consists of powdered tragacanth (4 parts), phenol and oil of bergamot (of each 1 part), olive oil (100 parts), and water (394 parts).

Great care should be exercised to prevent the spread of the disease by the use of common bath footboards, towels, socks, etc.

## HABITABILITY OF SUBMARINES

By D. N. CARPENTER, Captain, Medical Corps, United States Navy

One of the special qualifications for an efficient naval medical officer is a knowledge of submarine hygiene. He does not generally accompany the boat when it submerges, as the number of personnel is not sufficient to warrant the assignment of a doctor, but he should occasionally do so to know the conditions and to have the personnel realize he advises with such knowledge. The medical officers are attached to the "mother ship," where they care for the crew when sick and supervise the hygiene of the submarine. The officers and crew must be depended upon in time of emergency to render first aid and it is their education and indoctrination in hygiene of submarines that is part of the duty of the medical officers. There has always been the question of habitability of submarines, but, since this type of vessel has increased in size, the number of personnel has doubled, so that our largest V-boats now carry 96 men and officers. Instead of there being more room, there is even less than on the smaller boats, and habitability is becoming more and more important. Every new installation demands extra men to operate and maintain it.

The Planning Division of the Bureau of Medicine and Surgery is charged with the supervision of submarine hygiene, and it would seem desirable to bring to the attention of medical officers certain important conditions on which habitability depends.

During the World War the Bureau of Medicine and Survery issued submarine bulletins prepared by Capt. Eugene F. DuBois, United States Naval Reserve Force, the noted physiologist, who was then serving in the bureau. Commander E. W. Brown, who is our pioneer in submarine hygiene, first established the data on $CO_2$ production and oxygen consumption by personnel in submarines in a Report on Respiratory Vitiation of Air in Submarines, 1912. He also contributed an article in the BULLETIN for January, 1920, on "The medical and hygienic aspects of the submarine service," besides writing a special report on war patrol, which was included in the Surgeon General's report for 1919, and reports on the "Sanitary features of German submarines," "Air purification in British submarines," and "Medical and hygienic aspects of the British submarine service." There was published in the October and November, 1922, issues of the UNITED STATES NAVAL MEDICAL BULLETIN a translation of "Hygiene of submersibles," by Capt. C. M. Belli, Medical Corps, Royal Italian Navy, from Annali di Medicina Navale e Coloniale, Rome, February, 1922. These articles are exceedingly worth while, as they represent careful study, observation, and research. A more recent study of submarine ventilation in tropical waters appeared in the BULLETIN

for June, 1924. This was an investigation on the O and R types of boats by Commander R. F. Jones and Lieut. Commander G. H. Mankin. Doctor Jones, when attached to the submarine base at New London, also made a special study of the physical qualifications of the personnel for submarines and in the BULLETIN for July, 1926, there is an article by him on "The selection of personnel for submarines."

The dental officers, too, have been carefully observing the dental conditions of the personnel of the submarine service, and in the dental number of the NAVAL MEDICAL BULLETIN, published April, 1925, is an interesting article on "The importance of oral hygiene of submarine personnel." These articles have a great value for all medical officers.

In view of the fact that habitability is dependent on certain well-known principles of submarine hygiene, it seems advisable to discuss them. These include: First—Habitation space in compartments, approximately 150 cubic feet per man. Second—Ventilation, comprising air movement, purification, and dehydration. Third—Hygienic accessories.

Primarily it is a question of hull ventilation and air purification. It is submitted that this is not only of medical importance but has a direct bearing on efficiency of operation, besides conserving the duration of service of trained men.

There is a method of ventilating, which cools the air and removes water vapor, installed on all the S-boats and some of the R-boats. It is a main-induction ventilating system, with the ventilating trunk passing beneath the deck and over the hull, so that the air is cooled by sea water and water of condensation runs from the air ducts. There are two blowers, one on each end of the main trunk, which may be run either as supply or exhaust. The capacity of the blowers is 600 cubic feet per minute, and, as the average net air space of the S-boats is approximately 16,700 cubic feet, they will supply approximately 400 cubic feet of net air space per man. There is a complete exchange of air in about 28 minutes. The suction is from the motor room to the torpedo room. The diameter of the main trunk varies from 10 inches to 12 inches, which slows down the current of air and exposes the greatest surface to the cooling effect of the sea water. The trunk narrows to 7 inches as it delivers air to the torpedo room with increasing velocity. It has been noted with this system that when the temperature in the motor room was 120° the temperature of the air being discharged in the torpedo room was approximately 60°, the sea water at this time being about 40°. It was estimated that the temperature of the boat was thus reduced 15° in two hours. This system of ventilation was studied on the *R-23* by Jones and

Mankin. It would appear that the operating personnel do not always utilize this system when submerged, as they fail to appreciate the value of air movement and removal of water vapor in producing comfort.

In general, the ventilating system on the German submarines consisted of two main air trunks, the ends of the trunks being separated from each other in such a way that exhaust air could not be sucked in again by the supply trunk. The "heads" had exhaust connections, the galleys both supply and exhaust, and the largest storerooms either exhaust or exhaust combined with supply. The officers' quarters had supply and the crew space and batteries both supply and exhaust. There were special leads from the supply trunk to the engine room. There was a connection between the exhaust and supply ducts to permit each blower to do the work of the other by means of special shutters and valves.

The air ducts should be so placed as to give the most space in the living compartments. Although the single induction system requires less space and weight, the double supply and exhaust system provides more adequate air mixing and less liability to dead air spaces. It is considered advisable to provide drains for the ventilating trunks to drain the water from the shafts into the bilge. Independent cell ventilation should be supplied for the storage batteries, each cell having one or two fresh-air inlets, the air entering from the battery compartment, and the exhaust discharging outside the hull.

When submerged, the two gases that are important are oxygen and carbon dioxide. It has been found that carbon dioxide can be tolerated in much larger quantities than was previously thought, and that even when 3 per cent is present there may be very little or no indication of its effect on personnel except panting on exertion. There is a gradual and insidious absorption, which may not prevent the performance of general duties. Nevertheless, it has been found that after several hours of submergence the men become "dopy" and listless, characteristics of the effect of $CO_2$. It has been noted that releasing oxygen from the cylinders will "pep up" the crew; hence many submarine officers consider that oxygen is of primary importance. It is like taking a drink when one is fatigued. It temporarily whips up the individual, but there is no neutralization of the increasing $CO_2$ in his blood.

So far as is known there have been no experiments to show that in the presence of a toxic quantity of $CO_2$ the addition of excessive oxygen will overcome the effects of this poison. This is now being investigated at the Edgewood Arsenal. One can survive with a very small percentage of oxygen in the air (7 per cent, in fact). This is smaller than the amount present when a lethal quantity (8 to 9 per cent) of $CO_2$ might accumulate.

The value of providing oxygen is, therefore, considered entirely theoretical at present. Not only the United States submarines but most foreign submarines carry oxygen, and in the German service it was mandatory to resupply oxygen after 10 hours from a central cylinder with distributing pipes to the different compartments. In the British service during the war, upon the advice of Haldane, oxygen was not carried, as its value did not warrant the extra weight of cylinders. Dependence in case of need was from compressed air in the air banks.

It can usually be noted when the personnel show the effect of too much $CO_2$. On some of the German boats there was an apparatus permanently installed for the estimation of $CO_2$ as well as the quantity of oxygen. These devices were considered cumbersome and too fragile for practical use. It is suggested that a simple apparatus, similar to the Henderson-Orsat apparatus used in aviation medicine, be given consideration for use on our submarines. The Bureau of Construction and Repair Manual describes the Higgins-Marriott apparatus, which is less complicated.

The amount of soda lime that should be carried to neutralize $CO_2$ may be considered from two standpoints: First, a sufficient amount to obtain greater operating efficiency; second, an amount sufficient to meet sudden emergencies, in order that men trapped in any compartment may survive a reasonable length of time while rescue operations are being conducted. Each man will require one-half pound of soda lime per hour, or 12 pounds per day, and, as the amount of $CO_2$ under the normal conditions does not become toxic until after 17 hours of submergence, it is considered that to secure greater operating efficiency there should be carried 3 or 4 pounds per man per day for the estimated time of operation. This should be in a form for direct introduction into the ventilating system. To meet the demands of an emergency there should be carried 12 pounds per man per day for at least 72 hours. This would mean that a crew of 40 men will require a total of 1,440 pounds, to be distributed equally in the several compartments, because one can never tell which compartment will be sought for safety in time of an emergency. In the *S-5*, for example, when up-ended, it was the motor room, where usually only one or two men are on duty. In most accidents probably all this soda lime would be available; hence, with the use of air banks, it would suffice for approximately 100 hours.

An investigation at the Edgewood Arsenal to determine the total absorption value of Navy soda lime under emergency conditions was reported in part as follows:

A possible method of alleviating these conditions was suggested by Doctor DuBois in which the soda lime from the purifiers would be spread on the decks, ground to finer mesh by stamping on it with the feet, and securing

uniform exposure by raking it with a stick every two hours. In short, such a method would use the available soda lime as completely as possible in case of prolonged submergence.

In order to determine the performance of the soda lime under these conditions Doctor DuBois requested that the following question be answered: "How many grams of carbon dioxide can be absorbed by 1 kilogram of soda lime exposed for a period of 24 hours to the atmosphere containing 3 to 8 per cent carbon dioxide with a humidity of 80 to 90 per cent?" Doctor DuBois states that the prescribed conditions simulate those that would be found during a prolonged submergence. * * * Two sets of values are submitted: In the first case the soda lime was not stirred and in the second, stirring was used on a thinner layer. The effect of stirring is particularly marked on the 8 to 14 mesh since the latter results are about 40 per cent higher than the first. On the crushed samples better exposure obtained in the latter case increased the absorption about 16 per cent. The effect of agitation is to increase the surface exposed for absorption; if the material be very fine, agitation will have a small effect because the exposed surface is sufficient to utilize the absorptive capacity to a high degree, while, if the material be coarse, the effect on absorption of stirring in increasing the surface is marked.

The effect of concentration of carbon dioxide in the air is illustrated by the results without agitation. A comparison of the amount absorbed at 2.6 per cent and 6.6 per cent concentration shows that only a slight increase in absorption occurred at the higher concentration. A pound of the 20 to 28 mesh absorbed 2.65 cubic feet from the 2.6 per cent, and 2.76 cubic feet from the 6.6 per cent concentration. The 29 to 60 mesh absorbed 2.87 and 3.1 cubic feet per pound at the two concentrations. (The 8 to 14 mesh gave similar results, the absorption being 1.65 and 1.76 cubic feet per pound at the lower and higher concentrations.) At lower concentration an excess of carbon dioxide was present, particularly since the atmosphere was changed rapidly. The absorption is then largely dependent upon the characteristics of the material itself and an increase in concentration from 2 per cent to 8 per cent has only a slight effect. Again if the comparison were made on agitated samples, the difference would be still smaller.

* * * The amount of carbon dioxide absorbed during a 24-hour period is considerably affected by the particle size, a factor over which no control can be exercised when soda lime is spread about and crushed. It is obvious that the instructions should be such as to cause thorough and complete crushing.

Since the amount of carbon dioxide taken up is affected by several factors, such as particle size, agitation, depth of layer, rapidity of air circulation, etc., the answer to Doctor DuBois's question in regard to the capacity on a 23-hour exposure will be very much of an approximation. However, in order to make an estimate, it may be assumed that the crushing will give a 20 to 60 mesh product and that the average of the 20 to 28 and 28 to 60 absorption capacities will give a satisfactory indication. On this basis, the answer to the foregoing question is that 1 kilogram of fresh soda lime (of 20 to 60 mesh) when exposed to an atmosphere of 2 per cent to 8 per cent carbon dioxide for 24 hours will absorb approximately 400 grams of carbon dioxide (3.26 cubic feet at 32° F. per pound of soda lime).

The Bureau of Construction and Repair Manual describes the methods of use of soda lime very fully.

If, as a result of the research now being conducted at Edgewood Arsenal, oxygen is found to be of value, then provision should be made to carry it, not, as is now done, in separate cylinders, but with

distributing leads from a central tank to bleed into the different compartments.

The study by Jones and Mankin has shown that the temperature of the air in submarines, even in tropical waters, does not reach the danger point indicated in the experiments reported by Sayer and Harrington in a Public Health Report for 1921. The kata-thermometer can be used to indicate the "comfort conditions" at all times. There would seem to be no necessity, with the induction system and sea water cooling, to provide a special refrigerant to remove the excessive humidity, although it might give more comfort. On the Dutch *K–13* there was a "cooling plate" weighing 5½ tons. The Carrier apparatus using trichlorethylene as a refrigerant would weigh about 6 tons. Unless absolutely necessary, such a weight is prohibitive.

Cork paint has little or no value in reducing humidity. The use of cork sheathing and cork paint has a certain amount of hygroscopic effect, but its principal value is as insulation to prevent extremes of temperature; also cork helps to protect the metal surface from deterioration. This is one of the objections to the German method of sheathing, as there is no access to the metal except by removal of the sheathing every few years. In time of war the upkeep of the boats is not of the same importance as during peace, hence, if habitability can be improved by sheathing one may be willing to sacrifice the longer "life" of the boat. The German method of offsetting the sheathing or lagging from the hull so as to leave a space of an inch or two between it and the outside plating seems most desirable. This space can be ventilated by means of louvers at suitable places. The condensation taking place from the air coming in contact with the cold plating is drained into the bilge and pumped out periodically. Not only have Doctors Jones and Mankin, but Doctor Brown also has strongly recommended that small fans be installed in all the compartments, in addition to the blowers, to prevent air stagnation.

The following is the net cubic feet of air per man on United States submarines:

| | Cubic feet |
|---|---|
| F–boats | 262.08 |
| H–boats | 262.30 |
| K–boats | 282.41 |
| L–boats | 285.51 |
| M–boats | 366.51 |
| N–boats | 252.08 |
| O–boats | 269.69 |
| R–boats | 293.75 |
| S–boats | 388.37 |
| T–boats | 486.87 |
| V–boats | 450.00 |

These figures are based on net air space of different classes of United States submarines as shown in the Bureau of Construction and Repair Manual in accordance with personnel now assigned.

There are other important factors of submarine hygiene, classed as "accessories," which have to do with habitability. We should first consider the physical condition of the officers and crew. This has been fully discussed in Doctor Jones's article, where he emphasizes the importance of stability of the nervous system and recommends the highest standard for vision and hearing for all the officers and crew. In the Medical Department Manual, where the physical qualifications have been set forth, it has not been thought advisable to demand for the submarine service special physical requirements much greater than for general service, as it might eliminate a large percentage of men and interfere with transfers to different types of naval vessels. Only a small percentage of the submarine crew would be assigned for duty as listeners or for periscope observation. Such men should be required to have the highest standards of acuity of hearing and vision. The audiometer is of value to test combined air and bone conduction for those who have to use ear phones, but, as a routine method of testing hearing, it has been found to have its limitations, as it does not give the "quality" of sound that the human voice imparts. It will give pitch, dependent upon rapidity of vibration, and intensity, dependent on strength of the batteries. However, in conjunction with the voice-conduction test it is believed that the audiometer has its value as a test for listeners. The visual acuity of those who are assigned to periscope duty is of importance. Capt. Eugene J. Grow, in the NAVAL MEDICAL BULLETIN for July, 1912, discusses "Vision in relation to marksmanship," and this is still the "last word" on this subject to-day. If there is a marked astigmatism there is bound to be blurring of the image, due to defective parallax. Although periscopes have adjustable eyepieces, and we may choose men with perfect vision, yet it has been observed by submarine officers that there is a certain "knack" about their use that makes one man better than the other. The requirement is for monocular vision, hence one good eye might be trained for periscope duty.

There is no doubt that there is considerable nerve strain from services in submarines. If it is found that an individual does not react well to his environment he should be transferred to some other branch of the service. The individual should be intelligent, not easily affected by seasickness, and should have a good health record.

Artificial illumination has already been discussed by Belli, and we are in agreement with the recommendation that indirect illumination and frosted globes should be used when possible. On the German submarines there were special globes with the filaments arranged at

right angles to the long axis of the globe to reduce glare, and on some of their boats globular lamp shades with a combination of opal and light green were noted by Brown.

It is important to provide adequate toilet and bathing facilities, and there should be one water-closet bowl and one shower bath for the officers and two water-closet bowls and one shower for the crew of from 40 to 50 men. Sufficient space should be provided in the toilets, and bowls should be of a strong and efficient type. Even with the best arrangements there is a tendency to constipation of the crew of submarines from lack of exercise and intestinal stasis.

The psychological effect of odors from the engines, personal emanations, and cooking has already been discussed by Jones and Mankin. Cooking when submerged should be reduced to a minimum, with provision to economize the use of electricity and the open range by fireless cookers. The galley adds heat, odor, and moisture to the air. There should be provision for adequate steam heating on the surface and electric heating when submerged. The question of food supply when submerged is dependent on the difficulty of preparation and also on conservation. Necessarily, considerable canned food is used. Owing to the tendency to constipation, in preparation of the menus consideration should be given to a certain amount of "roughage," such as bran bread, to be included in the ration. When operating in northern waters the thermogenic values of foods should be considered. The vitamine content of green vegetables can be replaced by canned tomatoes and fruit.

Recently kelvinators have been installed on some of the United States submarines, and a special investigation of refrigerant was conducted at Edgewood. Some of these refrigerants are toxic or inflammable, but the one selected, iso-butane, was found to be, in the quantities used, practically nontoxic and noninflammable.

The scuttle butt can be refrigerated from the kelvinator. The water supply should be from a central tank, with emergency outlets in every compartment, for one can do without food but not water in case of accident.

As a protective measure against gasses, discussed by Doctor DuBois in Submarine Bulletin, No. 4, there is at present one gas mask provided for each member of the crew. With adequate ventilation of the storage batteries there should be little or no danger from hydrogen gas, but if salt water should gain access to the batteries the mask will be a protection from the chlorine fumes.

The amount of work to be performed when submerged should be reduced to the minimum, owing to the increased production of carbon dioxide. This is especially true if there should be an accident, when it is advisable to teach the men to lie down and keep as quiet as

possible, except those who have to be engaged in the endeavor to operate the boat.

For the maintenance of the individual's physical condition, attention should be paid to recreation and athletics, and, if possible, the crew should sleep on the tender when at the base. This would permit bunks to be reduced one-third, thus adding to habitation space and net cubic feet of air per man. Sufficient sleep and rest are important to offset the effects of strain and monotony which are evidenced by insomnia, loss of appetite, headache, etc. It is recognized that there must be the necessary overhaul of the mechanical features of the boat and that a certain percentage of the crew must be so engaged when alongside the mother ship. The important point is not to make this work so strenuous that it will interfere with the recreation of the crew.

The special diseases which should be borne in mind in caring for the personnel are as follows: Effect of prolonged exposure to gaseous vapors from the gas tanks or produced in combustion; disturbances of air pressure in the ear and the effects of the vibration of the Diesel engines; catarrhal affections of the respiratory tract from insufficient ventilation, oil "fog," or gaseous irritation; skin troubles, owing to the lack of bathing facilities; asthenopia from the prolonged use of the periscope, poor lighting, or glare; various nervous disturbances, especially in those with an unstable nervous system; dental gingivitis and Vincent's angina.

Dampness contributes to general discomfort and disease. When submerged the relative humidity of the air rises rapidly and, owing to the lowered temperature of the surrounding water, there is considerable condensation and dripping from the bulkheads. Under war conditions, with daylight submergence, there usually is an opportunity for air renewal when the boat emerges at night to charge the batteries. Active destroyer patrol may interfere with this, as was noted in the Baltic and Sea of Marmora during the World War. Under open-sea conditions all hatches except the conning tower will be closed, as the submarine must be ready for instant diving. In daylight cruising, whenever possible and the condition of the sea permits, the crew should be permitted on deck.

A special type of medical locker, with equipment and supplies carefully chosen, has been installed on some of our boats, and the V boats have a pharmacist's mate detailed for duty.

Medical officers, when giving first-aid instructions to submarine officers and crew, should specially emphasize the treatment of eye burns from the sulphuric acid of storage batteries; electric shock; chlorine burns from storage batteries; air purification by soda lime, and its emergency use; and the application of the gas masks.

It will appear, therefore, from the foregoing, that the training of the submarine medical officer is of considerable importance.

As stated by Commander Brown:

He must have a special knowledge of ventilation and gases in their relations to submarines; of the technique of air purification and the effects of increased $CO_2$ and decreased oxygen from the physiological standpoint; of such gases as chlorine and arsine; of the physiological effects of air pressure; of the functional tests for vision and hearing and of the treatment of such defects; of the physics and physiology of diving; and a special knowledge of the proper conditioning of men for this very exacting and arduous form of naval service. He is, in addition, frequently called into consultation on matters connected with the examination of water for battery purposes, of battery electrolyte analysis for impurities, and the testing of fuel and lubricating oil for sea-water contamination.

It is interesting to read what Doctor Brown reports of the deterioration of officers and men on war-time patrols.

This gradually developed as patrols proceeded. While in general not of a serious nature, it was indicated by loss of weight, pallor, the expression of the features, and general loss of tone, all the inevitable result of the monotony, defective atmospheric conditions, lack of bathing facilities, environment of artificial lighting, and a state of high nervous tension incident to antisubmarine warfare. The personnel tended to return from patrol in a fatigued condition, requiring two or three days for complete recuperation. The British submarine service had early recognized this state of affairs and the need for the adequate conditioning of the personnel by proper facilities at the base for comfort and recreation as well as frequent leave periods.

It was occasionally found necessary in the case of men debilitated by digestive, bronchial, and other affections to relieve them from patrol assignment, although not actually transferred to the tender. In the great majority of cases complete recovery resulted in two or three months and patrol duty was resumed. The important point was to keep a sharp lookout for such individuals and begin conditioning before they became actually unfit for duty.

The Manual of the Medical Department advises close supervision and frequent examination of submarine personnel, for we must not forget that this question of habitability is an important factor in the efficiency and morale of the submarine service.

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## ACUTE GINGIVITIS ASSOCIATED WITH FUSIFORM BACILLI AND SPIRAL FORMS

By C. H. Mack, Commander, Dental Corps, United States Navy

The available naval medical statistics fail to give an accurate measure of the prevalence of gingivitis associated with fusiform bacilli and spiral forms. In the Surgeon General's Report covering the calendar year 1925—the latest published at this writing—concerning the 661 admissions for Vincent's angina, the comment, "infections of the tissues about the teeth as well as the more typical

ulcerations of the tonsils are very commonly treated without admitting the patient to the sick list, and therefore recorded admissions do not represent the frequency with which cases of Vincent's angina are observed," is made (1). It is also to be noted that the figures for recorded admissions do not differentiate between the lesions of the mouth and those of the throat although one sufficiently incapacitated with the gingival infection would be admitted as having Vincent's angina. In the case of the statistics compiled from dental sources (2) for the same period, and listed as Vincent's stomatitis, the total of 2,151 is deceptive, in that this figure may include one case entered two or three times from as many different activities through which the patient may have passed. Hence there is no method of determining exactly how many individual cases are represented in the total reported.

However this gingival infection is one of the World War's sequelæ the incidence of which appears to be steadily on the increase among naval personnel—as well as in civilian life. It is judged to be of sufficient interest and urgency—at the risk of repeating much previously offered—to call to mind the necessity for its early recognition and treatment, its control as a disease that is communicable, and the use of any measures that will prevent its incidence. In general it is felt that the seriousness of the disease from a dental standpoint has not been appreciated. The loss of the interdental gingival crest, with its supporting alveolar process, that all too frequently occurs incidental to a severe acute attack is a permanent condition that almost invariably results in chronic suppurative peri-cementitis—less properly, but more commonly, called pyorrhea alveolaris. This means the eventual loss of many otherwise useful teeth, to the permanent impairment of the masticatory apparatus and a consequent effect on the general health of the patient throughout his after life. The pertinency of this last observation is clear when one considers that the disease is distinctly one afflicting young adults.

Another point of importance is that with the chronic or the recurrent type there is a definite and pronounced mental depression which has been observed, but is not recalled as being mentioned in the literature. In two cases under observation the depression was sufficiently pronounced to cause the patients to contemplate suicide—the one in the Navy, in the case of an officer, and the other recently in civil life, in the case of a university student. Nothing of original investigation by the writer will be offered in this paper, but an endeavor will be made to correlate data taken from original sources in a voluminous literature on the subject, to present it as briefly as possible, and to make use of such clinical experience as he has gained.

A review of the literature necessarily includes that of the more or less parent disease, ulcero-membranous inflammation of the throat associated with fusiform bacilli and spiral forms. Allowing the laurel for priority to rest where it may, this angina is commonly referred to by clinicians and statisticians with Vincent's name attached and the organisms as Vincent's organisms.

## Historical

Although the first definite mention of a gingivitis associated with fusiform bacilli and spiral forms was made in the late nineties, in connection with bacteriological studies, and it is only since the beginning of the World War in 1914 that present-day observers have come in contact with it in large numbers of cases, it seems certain that it is not a modern disease. Vincent (3) found mention in medical history of a disease giving the same clinical picture having occurred in epidemic state in the wars of the Revolution (French), the war with Spain (French), occurring later in garrisons in times of peace, in regimental epidemics, and on board naval vessels in extensive and rebellious forms. Further—as now—it was not limited to the military. Grieves (4), in our naval dental service during the late war, raises the question that had occurred previously to many, if scorbutus—the scurvy of such common incidence among mariners of other days—would not have yielded the same bacteriological results.

## Literature

In 1894 Plaut (5), a German investigator studying diphtheria and throat anginas, demonstrated the fusiform bacilli and spirilla, and, in 1896, Vincent (6), a French Army surgeon with the Colonial Army in Africa, working on the bacteriology of the even then rarely met hospital gangrene, also described the same bacteria in his paper, offering excellent photographs. Bernheim (7), an Austrian, in 1897, reported a study of 30 cases and was apparently the first to include mouth lesions as a source of his material. Niclot and Marotte (8)—also of the French Army medical service—presented their well-prepared paper reporting original work and reviewing previous studies in different phases of the disease, including mouth lesions. It is to be remarked that up to this time no American investigators had made reports. In 1902 Mayer (9), having a service in a New York City hospital, reported a single case, with a well-carried-out bacteriological study, in which both the throat and gingival tissues were involved, and he was followed in 1903 by Fisher (10), pathologist at a Connecticut State hospital, who reported studies and bacteriological findings in two cases, both with mouth involvement. In 1904 Crandall (11), a St. Louis practitioner, reported the study of a single case with severe gingival lesions. In 1904 and 1905 Vincent

(12) (13) made extensive researches of the gingivitis now called by his name. In 1905 and 1906 Weaver and Tunnicliff (14) (15), of Chicago, and, in 1906, Tunnicliff (16) alone reported very complete and authoritative studies of fusiform bacilli and spirilla from tonsillar and gingival lesions. These investigators cultivated organisms under anerobic conditions which corresponded morphologically and histologically with those described by the European writers. In 1911 Tunnicliff (17) published her paper containing evidence, to her satisfaction, that the fusiform bacillus and the associated spirillum were different forms of the same organism. The same year Chamberlain (18), of our Army Medical Corps, working in the Philippines, presented a thorough paper on his findings of associated spirochetæ and fusiform bacilli from lesions in the throat, mouth, skin, and lungs. In 1912 Vaughn (19) reported what was then a large series of 17 cases which he called "ulcerative gingivo-stomatitis." In 1913 Krumwiede and Pratt (20) contributed a bacteriological study of the organisms. The writings of clinicians during and after the World War are very extensive but, in general, present little of permanent value to the literature which was not previously covered. Credit is hereafter given where any use is made of reports not previously mentioned. In 1923 Tunnicliff (21) presented further proof of her thesis that the fusiform bacilli and spirilla are different forms in the life cycle of one organism.

While use to some extent has been made in the part of the paper that follows of the reports of all the authorities cited, the writer has found those of Doctor Tunnicliff to be the ones upon which he has drawn most freely. He feels indebted to this well recognized authority also for personal suggestions, as he does to Prof. A. A. Day, of Northwestern University Medical School, Dean D. J. Davis, of the University of Illinois College of Medicine, and Dr. E. C. Rosenow, of the Mayo Foundation.

### Definition

Acute gingivitis associated with fusiform bacilli and spiral forms has been described by Gilmer (22), who named it acute ulcerous gingivitis, as one that "attacks simultaneously the gum margins on their buccal or labial aspect about three or possibly four teeth only at the same time. These ulcers seemingly come suddenly, quickly destroying the gingiva down to the alveolar process, but seemingly not invading it, baring the roots of the teeth to this extent. The margins of the ulcers are everted, crater like, somewhat similar to chancrous ulcers. The bases of the ulcers are overlaid with grayish-white covering. When this covering is removed the granulating surface bleeds freely. The lymphatics related to the area become

enlarged, and, unlike chancrous lymphatic enlargements, are tender. It is also unlike chancre in that the ulcers are exceedingly painful to touch. Salivation is much increased, the breath is fetid, and, owing to the absorption of toxic elements, there is a rise in temperature. The contiguous lingual gingivae become reddened, but do not participate in the ulceration." Gilmer's description is submitted as the classical one for, though the passage of time, with the unusual incidence of cases during and since the World War, would permit some changes, it, in the main, presents an accurate picture not equaled in terseness by others. Such changes in, or better, additions to, this description as seem necessary may be noted later.

### Synonyms

Acute ulcerous gingivitis, Vincent's infection, Vincent's gingivitis and stomatitis, trench mouth, ulcero-membranous gingivitis, necrotic gingivitis, and gangrenous gingivitis.

Other lesions about mouth and throat associated with same bacteria: Noma, Vincent's angina.

### Incidence

Commonly among young adults—especially males between ages of 18 and 25. In the Navy, enlisted personnel present highest percentage, though it is not uncommon among younger officers.

### Etiology

Advisedly, the title of this paper named this acute gingivitis as "associated with" the fusiform bacilli and spiral forms rather than "caused by," for, unfortunately, to a certain degree, the proof is lacking to show definitely that these organisms are the cause, although countless corroborating observations testify to their occurrence in preponderating numbers. Certain it is that their presence can be said to be characteristic of the disease. While Davis and Moorehead (23) incline to the belief that the organisms are ordinarily to be classed as opportunists—that is, that they are secondary invaders of tissues previously infected or weakened—there is adequate proof of their statement that they may attain a high degree of virulency which permits them to attack primarily. The list of predisposing causes, though imposing, is generally agreed upon and may be divided as follows:

*Abuses.*—In the use of alcohol and tobacco (especially smoking).

*In connection with the teeth:*

- Neglected teeth (extensive caries or broken-down roots).
- Neglected mouth hygiene (especially deposits of salivary or serumal calculus).
- Eruption of teeth (especially lower third molars).
- Irritation from crowns, bridges, or fillings.

*Other lesions in or near mouth:*
Other infectious processes.
Those in the throat (Vincent's angina).
Those of the infectious granulomata.
Broken-down neoplasms.
Traumatic (especially from use of toothtpicks or too vigorous use of dental floss).

*Poisons:*
Metallic intoxication.
Auto-intoxication.

*Constitutional:*
Especially blood-deficiency diseases, such as anemia and leukemia.
Diet-deficiency diseases.

*Blood supply.*—Vascular changes.

In fine, any debilitating influences that lower the normal resistance of the tissues to bacterial invasion. Syphilitics, especially those with a mercurial stomatitis, show an extreme predisposition.

## Bacteriology

When the disease is at its height a smear from the lesion yields almost a pure culture of fusiform bacilli and spiral forms—so commonly known as Vincent's organisms—occurring in a characteristic relationship that suggests a symbiosis. While several staining methods are used, the writer has found the following to be the most serviceable and the simplest: Fix the smears by passing slide lightly through flame. Cover with gentian violet as compounded for Gram's method. Steam gently for one minute. Wash off in water and dry with blotting paper. The fusiform bacilli are generally observed as spindle shaped—hence the name—and are from 5 to 10 $\mu$ in length, though a variation in morphology is noted in that they sometimes occur as thicker rods with rounded ends. A newer nomenclature designates them as the *Fusiformis dentium.* They are ordinarily considered nonmotile, are Gram negative, and are obligate anerobes. The spiral forms found in apparent symbiotic relation with the bacilli are more commonly named spirilla or spirochetes and, in later terminology, are referred to as *Borrelia vincenti.* These are long and delicate, varying from 10 to 25 $\mu$ in length, and present four or five graceful turns. They are usually quite motile, but, like the bacilli, are Gram negative and obligate anerobes. As they stain much more faintly than the bacilli in a lightly stained preparation, they might be overlooked. It is of historical interest to recall that spirilla were among the first bacterial organisms seen by the human eye, since Leeuwenhoek, the Dutch pioneer in microscopy, described them in calculus removed from the teeth in the year 1683. While the exact identity of these spiral forms has not been determined, and it is not definitely known whether they are of one or of several

species, from a clinical view the point is quite academic, since they react so uniformly to treatment. The same might be said of Tunnicliff's belief that the fusiform bacilli and spirilla are different forms in the life cycle of one organism. This view has not been generally accepted, though her standing as a precise and conservative investigator has insured respectful consideration being given to it. In a late paper, Varney (24) criticizes her technic and believes her cultures were not pure, though Hadley's (25) work, of monumental proportions, on "Microbic Dissociation" may lend further credence to the thesis. Davis and Pilot (26) (27) have made important contributions as to the habitat and distribution of the organisms in health and disease—supplementing Chamberlain's, before mentioned (28)—showing their presence in the apparently healthy, in tonsils, the mouth, and about the genitals; in disease processes, in pulmonary abcesses, gangrene, and bronchiectasis.

### Special Anatomy

A short review of the histology and anatomy of the gingival tissues as offered by Keilty (29) appears worthy of quoting: "The tissue is composed of a stratified and modified epithelium covering backed up by a loose connective tissue which is without glands and is not very vascular. The connective tissue is directly continuous with the periosteum of the alveolar border and the pericementum of the tooth. When the protective power of the epiderm is once invaded the connective tissue offers a poor barrier which is at once probably augmented by the cells of the wandering connective tissue type and, in addition, by those derived from the blood."

### Pathology

The primary point attacked is the interdental gingival crest or around the loose tissue near a partially erupted lower third molar. A pseudomembrane varying in color—grayish, whitish, yellow, yellowish brown, or greenish usually exists. While this may be pierced by small hemorrhages there is always a bleeding surface when the membrane is removed. The destructive process is frequently deep, causing the alveolar crest to disappear also. The borders of the ulcers are pointed, irregular, and undermined. That the spirilla are the most concerned with the extensive solution of the tissues is generally believed, while the earlier inflammatory processes and the putrid odor are attributed to the bacilli. To Tunnicliff (30) we are again indebted for an enlightening report with excellent microphotographs of stained sections of an ulceromembranous tonsil removed during life. These show an exudate containing cocci, a variety of bacilli, and a few spiral organisms; under the exudate the external epithe-

lium is necrotic and contains only an occasional coccus, fusiform bacillus, and spiral form. The layer between this necrotic tissue and living tissue contains a few leucocytes, a moderate amount of fibrin, and enormous numbers of the fusiform and spiral organisms. Their presence in the deeper tissue is probably due to their being anerobic organisms. Living tissue seen underneath this mass of organisms appears to be invaded by both organisms—the spirilla just ahead, or considerably in advance, of the bacilli and being more numerous. In this respect the picture of the arrangement of the organisms is in reverse to that seen during the early incidence when the bacilli are greatly in excess and the spirilla may sometimes be lacking.

### Symptoms

In the milder and more insidious types there may be no pronounced symptoms except some bleeding and a vague pain in the jaw that is frequently described as an indefinite sort of toothache. These cases demand careful attention to discover the lesion, and the typical clinical picture may be entirely lacking. The more easily diagnosed cases present quite a classical chain of symptoms, such as feeling of discomfort in mouth, lassitude, restlessness at night, loss of appetite, headache, coated tongue, usually some constipation, and, in some cases of greater virulency, chills and fever. Ordinarily there may be little sign of fever, though cases with over 103° F. are recorded. One or two days later the local lesions are in evidence, pain may be experienced in swallowing, salivation, and a peculiarly fetid breath, as from a putrid source, arise. If no membrane exists considerable bleeding of the gums may occur.

### Complications

Although complications are not often encountered, there are reports of albuminuria, herpes, gastroenteritis, noma of the cheek, and of the more serious endocarditis and pneumonia.

### Prevalence

The disease is undoubtedly more prevalent than is generally considered—perhaps because it may run a mild course and be disregarded by the sufferer.

### Contagion

Modern conceptions place every infectious disease as potentially contagious. That this disease is communicable through close contact is frequently apparent from the occurrence of small epidemics among the personnel of ships where men live in especially close quarters, as on tugs, submarines, and destroyers, as well as in certain

divisions, watches, etc. It is supposed that the most common means of contagion in the naval service are included in the following lists:

*Among officers.*—(*a*) Improper technic in the washing and sterilization of mess gear.

(*b*) Use of common drinking glasses at the ice-water tank in the mess rooms.

(*c*) Mess attendants with the disease—or those who may be carriers—getting the infection on their hands and in turn infecting utensils upon which food or drink is served.

*Among enlisted personnel.*—(*a*) Taking a cigarette, pipe, or cigar from the mouth of another when out of "smokes."

(*b*) Improper technic in the washing and sterilization of mess gear.

(*c*) Cooks, mess cooks, and any others handling food having the disease—or who may be carriers—getting the infection on their hands and in turn infecting the mess gear.

(*d*) Use of a common drinking can—especially among the men of the engineering divisions in the fireroom.

(*e*) Buglers, musicians, and boatswain's mates using bugles, instruments or boatswain's whistles which are blown by others.

(*f*) Touching lips or tongue to telephone mouthpieces, speaking tubes, etc., in the use of the ship's communication system.

## Diagnosis

The typical acute condition, with the punched-out appearance of the ulcers, and the peculiarly offensive fetid breath make a clinical diagnosis simple. As stated, a smear gives a picture of the fusiform bacilli and spirilla in an apparently symbiotic relationship in almost pure culture.

## Differential Diagnosis

Hatton (31), in a concise paper, associates tuberculosis and syphilis of the mouth in this connection. Tuberculous lesions of the mouth are of such rare occurrence among Navy personnel that they may almost be counted as nonexistent. As regards syphilis, the slightest suspicion or doubt—as there may well be in the case of the degenerative forms of the mucous patch or when it has in later stages acquired a mixed infection—would necessitate it being considered such temporarily until a definite diagnosis by serological tests is made. Chronic suppurative pericementitis (pyorrhea alveolaris) should never be mistaken for this form of acute gingivitis since, ordinarily, the presence of pus would serve to indicate the former and rule out the latter.

## Prognosis

While in a given case the prognosis may be good, one must have clearly in mind that there may be considerable destruction of important gingival tissue and the underlying alveolar process and that

gangrenous processes and noma of the face may follow. The tendency of the disease to recur after partial or apparently complete recovery must also be considered.

### TREATMENT

To clinicians the paragraph discussing treatment is usually the most attractive. If it has seemed that unnecessary description and discussion has preceded it, this should not deter its being reviewed fully, for there is no disease that rewards a thorough understanding more completely in the development of a satisfactory technic of treatment and of a rational basis of medication. With the knowledge that the organisms characteristic of the disease process are anerobic, it is at once evident that, in the topical application of drugs, every particle of all membranous layers and necrotic tissue covering the inner surfaces being attacked offers an effectual barrier that must be thoroughly and completely removed. It is not judged to be possible to accomplish this with the method so commonly employed of spraying solutions under compressed-air pressure, owing to the peculiar anatomical arrangement of the involved part. Each particle must be removed by a mechanical procedure, preferably with absorbent cotton pellets held in pliers or cotton attached to wooden applicators, permitting the application of a sufficient, if delicate, force and exacting attention must be given to exposing every related nook and crevise. As this process may be an extremely painful one, the suggestion is here offered that benzyl alcohol be first applied to the lesion for its local anesthetic action, which is deep penetrating though not long lived in effect. Following the removal of the membrane and slough, the area should be thoroughly irrigated to get rid of any loosened particles of tissue, employing a water syringe with a large-gauged point—in hospitals and other places where convenient the use of the Pulitzer bag irrigation works remarkably well for this purpose—and a bland solution, preferably normal saline. Some confusion has existed on account of the large number of remedies recommended, yet an analysis will show that they fit into a comparatively simple classification.

*Oxidizing agents*.—The fact that the organisms are obligate anerobes also furnishes a reason for using drugs of this group, especially in combating their action by supplying oxygen. These agents are used in two ways: For topical application, hydrogen peroxid, sodium perborate, and chromic acid are the most commonly employed; in mouth washes, potassium permanganate and potassium chlorate are made use of. Hydrogen peroxid is applied pure on cotton swabs; sodium perborate is mixed with water to make a paste and directly applied; chromic acid is ordinarily used in a 10 per cent

solution and applied on cotton swabs. As a mouth wash, potassium permanganate solution, 1 to 2,000, also acts as a deodorant. Although a saturated solution of potassium chlorate has proved very satisfactory in many clinics, its toxic effects, if absorbed through the pharyngeal tissues—especially when used as a gargle also—must be kept in mind.

*Remedies with spirocheticidal action.*—The generally recognized value of arsenic preparations in this connection has brought into use Fowler's solution, arsphenamin, and later neoarsphenamin. Perhaps the most general use of the Fowler's solution was made in the British Army during the World War, but it is quite commonly used in America. The U. S. P. preparation is employed and it is applied to the lesion, with care being taken to block off the mouth with gauze and cotton rolls—as, indeed, should be done in all treatments. Neoarsphenamin used in a 5 per cent glucose solution has been found of great value, though reports of use of 5 per cent and 10 per cent solutions in glycerin are not uncommon. The use of neoarsphenamin as a dusting powder is not to be recommended on account of the dangers of its absorption into the circulation in toxic quantities.

While the intravenous administration of this drug has been recommended, there is really no justification for such treatment, as Hatton (32) points out, "as the infection is purely a local one and the mortality almost none. The systemic effects are due wholly to the absorption of toxic material through the mouth mucous membrane and through the gastrointestinal tract. The arsenic is needed only in the mouth and there in as concentrated form as is possible. Intravenous administration is a prolonged way of getting the arsenic to the mouth in a dilute form; furthermore, there is a distinct risk to the life of the patient in the intravenous administration of the arsenic preparations, and the death rate, though low, as in anesthesia, is nevertheless positive. Such a death in the treatment of acute ulcerous gingivitis is without any mitigating circumstances." To civilian practitioners especially this statement contains food for thought, written, as it is, by a physician lately connected in a responsible capacity with the coroner's office in America's second largest city. If its tenets are generally concurred in by medico-legal officials, its quotation is judged to be relatively of great importance.

*Astringents and caustics.*—Copper sulphate and silver nitrate may be classed in this group. Copper sulphate is used in solutions of strength varying from 2 to 20 per cent; silver nitrate in solutions as high as 50 per cent. If one of these drugs is to be used the former is suggested as preferable.

*Antiseptics, disinfectants, germicides.*—Largely during the last decade the use of synthetic dyes has been introduced in medicine and

very promising results have been reported concerning their use in treating acute gingivitis by either topical application or as irrigating solutions. Among the more prominent are:

Of the acridine group: Neutral acriflavine in 1:1000 solution for irrigating purposes.

Of the fluorescein group: Mercurochrome—220, soluble, in 10 per cent solution applied topically.

Of the rosaniline group: Gentian violet; crystal violet. Used in strength varying from 1:500 to 1:1000 for topical application.

Of the miscellaneous group: Methylene blue in 1:1000 solution applied topically.

*Anodynes.*—Compound tincture of benzoin or argyrol are sometimes useful, following the treatment, for their soothing effect on the lesion and such protection as they may afford from the mouth fluids. Continued pain would indicate a continuous irrigation along the lines outlined.

*Cold as an agent.*—The clinical advantages of cold as an aid to treatment have not been mentioned in literature, though experiments are warranted being carried on by the report of Varney (33), who found in his work in the bacteriological laboratory that the fusiform bacilli were more sensitive to cold than to oxygen. The writer suggests that these experiments might include the use of ice-cold irrigating solutions and mouth washes and the use of a refrigerative agent, such as ethyl chloride, as a spray on the lesion itself.

Sodium perborate, used as described, followed by the 5 per cent solution of neoarsphenamin in glucose, is offered as a treatment that is at once logical and productive of results. However, it is felt that failures may be accounted for more by neglect to observe the preliminary steps outlined—clearing away thoroughly the membrane and slough and giving detailed and exact attention to the application of the drugs—than by an unfortunate choice of the remedies employed. Ordinarily, treatment at the dentist's hands twice daily is sufficient if conscientiously given, even at the height of the acute stage, but the whole-hearted cooperation of the patient is absolutely necessary. This is given by such mechanical cleaning as permits, with abstinence from smoking and alcoholic indulgence, and the use of a sodium perborate paste applied to the lesions, to be followed by a mouth wash (potassium permanganate, 1:2000, is suggested) when the sodium perborate's repeated use becomes irritating. The length of the treatment depends on the severity of the case and the cooperation of the patient. In connection with the latter, it is to be recalled that while the benefits to be obtained through individual hygiene are enormous, they are limited to the best of which any given individual

may be capable. The time taken for treatment has been grouped into three divisions:

Case yielding within 10 days: Ordinary case—good cooperation of patient.

Those requiring 10 days to 3 weeks: When the acute phase ends and a sort of chronicity begins.

Those requiring 3 to 6 weeks: Ordinarily poor cooperation from the patient.

While mention of it has not been made, it is expected that attention shall be given to that very important trio, elimination, rest, and diet, as well as to the removal of any of the predisposing causes listed that may exist in the case in hand, special attention being given to the tonsils, since it would not be possible to clear up the gingival lesions with foci existing in the pharynx.

In general, surgical procedures involving removal of roots or teeth should be delayed until the highly acute condition has subsided. The practice generally resorted to in the Navy dental service of using rubber gloves in treating cases having lesions of the soft tissue is well founded, and it is predicted the practitioner of the future will wear them to a much greater extent than is being done to-day in routine dental operative work.

## Conclusion

There still remains much investigation and study to be carried on in connection with the fusiform bacilli and spiral forms associated with this disease which will have a decided clinical bearing. It is considered that the Navy affords an excellent field for these studies, which have been outlined and referred to the Bureau of Medicine and Surgery, and include:

1. The determination in a large series of cases of the extent to which fusiform bacilli and the associated spirilla, commonly known as "Vincent's organisms," occur in the apparently normal mouths of vigorous young males as represented by recruits in the Navy. If found to be of constant occurrence, it would indicate:

(*a*) The unreliability of the practice employed by many of endeavoring to get negative smears from the mouths of those who have had an acute gingivitis associated with fusiform bacilli and spiral forms as a necessary proof that the disease is cured.

(*b*) It would indicate in a general way that the incidence of the disease may be accounted for, in a larger extent than has been considered, by the lowered resistance of the host and the increased virulency of the strain harbored, as well as that it may be communicated by another person having the disease or by a carrier.

(*c*) It would explain also that type of case which occurs in mouths where exceptionally good hygienic conditions obtain, since it is known that the virulence of an organism, or organisms, may increase to that extent which allows it, or them, to attack successfully healthy tissue.

(*d*) It would, possibly, account for many of the milder types of gingivitis not heretofore associated with these organisms and would also account for recurring types and those tending to chronicity.

(*e*) If found to be regularly harbored about salivary calculus it would give added impetus to the already recognized movement for more frequent prophylactic measures at the dentist's hands as a preventive measure.

2. An accurate study of cases of acute gingivitis associated with the fusiform bacillus and all circumstances in connection with it would permit:

(*a*) Reliable statistics as to its prevalence.

(*b*) The knowledge of the relationship of one case to another, or others, with which contact is possible—that is, its epidemiology.

(*c*) The evidence becoming available that enough attention is not given to its recognition and cure, or to its prevention.

(*d*) An appreciation that the destructive processes in which the interdental gingival crest and underlying alveolus are involved produce a permanent condition almost invariably followed by chronic suppurative pericementitis (pyorrhea alveolaris). This means the eventual loss of many sound teeth and the consequent impairment of the dental mechanism, all of which produces a pronounced effect on the general health of the patient throughout his after life.

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## A CONSIDERATION OF GALL-BLADDER SURGERY

By Rea Smith, M. D., Captain, Medical Corps (Vol. G.), United States Naval Reserve[1]

The choice of operation in the surgery of the gall bladder furnishes an unfailing subject for controversy, depending upon the personal experiences of individual surgeons.

During the last 10 years in gall-bladder surgery the swing of the pendulum has been wide in each direction, from the center of conservative and reasonable treatment of infection, or the results of infection (gall stones), of the gall bladder. Ten years ago in the larger clinics, where the policy of gall-bladder surgery is molded, the cases ran 80 per cent drainage and 20 per cent removal. Because of a failure of symptomatic cure in between 5 and 10 per cent of the patients treated by drainage for all types of gall-bladder disease, the pendulum has swung back, so that three years ago in the same clinics the proportion of removal was 90 and the drainage 10. Removal of the infected gall bladder has undoubtedly cleared up the symptoms for which the patient was operated upon in a larger per cent of cases than the simple drainage.

In the last two or three years a new type of surgery of the biliary tract has come into prominence, that of common duct obstruction without stone and without new growth. This difficulty following cholecystectomy has necessitated a secondary operation, which has proved very difficult of performance and to have a very high mortality. In all of these cases that I have had an opportunity of studying, the foramen of Winslow has been closed. The lumen of the common duct has been obliterated in more or less its entire length by a secondary contraction of the inflammatory exudate surrounding it. In view of the fact that the removal of the gall bladder is likely to be followed by a complication so serious that it necessitates a life-saving operation, while the secondary operation for drainage is simple and not attended with a high mortality, the question arises whether or not more care in the selection might not be used in those cases to be drained and those to be removed, or, perhaps, a change in technic in the gall-bladder removal, which would prevent the loss of the normal support of the common duct and the collapse of the foramen of Winslow, and so hold the common duct out of the lake of plastic lymph that collects in the fossa between the right kidney and vertebral column, so that this obstruction would not occur.

The steps in the ordinary technic of gall-bladder removal are familiar ones, whether done from above or below. The cystic duct is isolated, ligated, and dropped back. The cystic artery with its surrounding tissue is ligated and dropped back. The gall bladder is

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removed from its attachments to the liver and the raw surface covered over. It occurs to me that the isolation and the dropping back of the cystic duct take away the normal support of the common duct, and allow the common duct to lie slack against the posterior peritoneum in the edge of the lesser omentum. The common duct is, therefore, lying in more or less of a pool of plastic lymph and is surrounded by a thick membrane, which slowly contracts until the lumen of the duct becomes partially or wholly obliterated. This process is a slow one and our bad results do not become urgently manifest for a period of from several months to two or three years, so that the benefit by a change of technic must of necessity be very hard to prove. However, in face of the facts that common duct surgery after cholecystectomy is becoming more and more necessary, and the constant finding of the inflammatory obliteration of the duct adherent to the posterior parietal peritoneum is, to my mind, justification for an attempt to leave the support of the common duct undisturbed in the removal of the gall bladder. In many cases it is a very simple procedure to cut the peritoneum of the gall bladder parallel to its attachment to the liver on either side, and, from above downward, peel out the gall bladder mucous membrane to the cystic duct. The cystic duct is then ligated, without isolating it from its surrounding tissue, below the point of ligation, so that the stump of the cystic duct has the same support through its attachment to the liver by the tissue intervening, that it had from the gall-bladder attachment to the liver. This support can be regulated by the ligatures or sutures between the stump of the duct and the liver. In cases in which the wall of the gall bladder is so thickened that it can not be peeled from the liver in the manner described above, a peritoneal cuff is made from the lower anterior surface of the gall bladder continuous with the peritoneum of the cystic duct, and this cuff is stitched to the denuded surface of the liver. Neither of these procedures lengthens the time of the gall-bladder removal, nor adds to its danger, and, except in the short, fat patient, with deep contracted gall bladder, is of easy performance.

It seems to me that three distinct elements enter into the problem of selection of operation. They may be alone or in any combination. Usually all three are present in the same case. They are—

(1) Mechanical obstruction of biliary passages.
(2) Infection of gall-bladder walls.
(3) Infection of liver ducts.

The mechanical obstruction unaccompanied by active infection, of course, is simple, because it must be relieved mechanically, and the operator chooses the way that is easiest for him to do.

No one will contend that the grossly infected gall-bladder wall should be left under any circumstances that would permit of its removal.

In the presence of the third condition, I think that whatever is done, drainage of the liver ducts must be a part of the procedure.

This sounds very simple if these conditions would occur singly, but in the nature of the development of gall-bladder disease it is almost impossible to have a gall-bladder condition demanding operation which does not have a combination of at least two of the three elements.

McArthur and Lobingier have reiterated for years the fact that the diseased gall bladder is only a small part of the general infection of the biliary tracts, and that, as a routine operation (if a routine operation is to be used), one that drains the bile ducts will effect a cure in a larger percentage of cases than one in which drainage is not considered. I am sure that they are right in this, and I am also sure that many different surgical shifts may be used to accomplish a removal of the infected gall-bladder wall and drain at the same time, so that it will not be necessary to make a flat choice between cholecystectomy and cholecystotomy.

In conclusion, I should like to mention a change in method of separating the gall bladder from the liver that not only seems to make the removal technically much easier but also leaves the liver surface smooth, avoiding the necessity of any sewing to cover denuded surfaces. I am in a quandary whether to call it the hydraulic method or the method of infiltration dissection; either describes it. A 10-cubic-centimeter syringeful of salt solution is injected between the gall bladder and the liver under the reflexion of the peritoneum, which immediately balloons. Upon dividing the peritoneum, the gall bladder is found to be separated entirely from the liver except for the peritoneum on either side, which is divided without oozing. The solution under tension seems to separate the two structures in the normal plane that a knife or blunt dissection will not follow, and it has been a great surprise to me to see how easily the old bladders, adherent from chronic or repeated attacks of inflammation, remove themselves with the judicious use of a little fluid.

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## ANTITYPHOID VACCINATION IN THE UNITED STATES NAVY; EXPERIENCE OF 14 YEARS

By J. C. Pryor, Captain, Medical Corps, United States Navy

The outbreak and continuance of any epidemic of infectious disease is the resultant of several known and perhaps some unknown forces. Consequently, evaluation of preventive methods is difficult.

The caviling critic comes with the question, "How do you know that X would have been attacked by the disease if he had not received the prophylactic?" This question can not be answered in a given case.

So many factors, such as heredity, immunity, the lowering of resistance, the virulence of the organism, the actual number of virulent organisms invading, the wider dissemination of knowledge, better sanitation, etc., enter into the shaping of the end result that it is difficult to form an opinion (far more so a logical deduction based upon data expressed mathematically) without comparing the morbidity and mortality rates for communities throughout years of experience with a given prophylactic method.

A study of these rates as they pertain to the movement of typhoid fever in the United States Navy for the past 26 years may prove of interest to us to-day, as we contemplate the epidemic of typhoid fever which at this writing is costing the population of Montreal so much money, suffering, and life. Montreal has had 4,755 cases of typhoid fever from March 1, 1927, to June 28, 1927, with 453 deaths.

Herewith is published, with the permission of Admiral E. R. Stitt, Surgeon General United States Navy, a table showing the actual number of admissions and deaths for typhoid fever in the United States Navy, with rates per 100,000 for each since 1899.

*Typhoid fever—1900 to 1926, inclusive*

[Includes paratyphoid fever]

| Year | Average strength, Navy and Marine Corps | Admissions | Admission rate per 100,000 | Deaths | Death rate per 100,000 | Indicated case fatality rate per 100 |
|---|---|---|---|---|---|---|
| 1900 | 23, 756 | 175 | 736. 66 | 25 | 105. 24 | 14. 29 |
| 1901 | 26, 873 | 105 | 390. 73 | 14 | 52. 10 | 13. 33 |
| 1902 | 31, 240 | 125 | 400. 13 | 14 | 44. 81 | 11. 20 |
| 1903 | 37, 248 | 188 | 504. 73 | 20 | 53. 69 | 10. 64 |
| 1904 | 40, 555 | 194 | 478. 36 | 21 | 51. 78 | 10. 82 |
| 1905 | 41, 313 | 172 | 416. 33 | 11 | 26. 63 | 6. 40 |
| 1906 | 42, 529 | 230 | 540. 81 | 14 | 32. 92 | 6. 09 |
| 1907 | 46, 336 | 249 | 537. 38 | 17 | 36. 69 | 6. 83 |
| 1908 | 52, 913 | 176 | 332. 62 | 10 | 18. 90 | 5. 68 |
| 1909 | 57, 172 | 189 | 330. 58 | 17 | 29. 73 | 8. 99 |
| 1910 | 58, 691 | 193 | 328. 84 | 10 | 17. 04 | 5. 18 |
| 1911 | 61, 399 | 222 | 361. 57 | 15 | 24. 43 | 6. 76 |
| 1912 | 61, 897 | 57 | 92. 09 | 2 | 3. 23 | 3. 51 |
| 1913 | 65, 926 | 23 | 34. 89 | 4 | 6. 07 | 17. 39 |
| 1914 | 67, 141 | 20 | 29. 79 | 0 | 0 | 0 |
| 1915 | 68, 075 | 23 | 33. 79 | 1 | 1. 47 | 4. 35 |
| 1916 | 69, 294 | 21 | 30. 31 | 0 | 0 | 0 |
| 1917 | 245, 580 | 86 | 35. 02 | 1 | . 41 | 1. 16 |
| 1918 | 503, 792 | 83 | 16. 48 | 9 | 1. 79 | 10. 84 |
| 1919 | 298, 774 | 49 | 16. 40 | 2 | . 67 | 4. 08 |
| 1920 | 140, 773 | 35 | 24. 86 | 7 | 4. 97 | 20. 00 |
| 1921 | 148, 861 | 16 | 10. 74 | 1 | . 67 | 6. 25 |
| 1922 | 122, 126 | 12 | 9. 82 | 2 | 1. 64 | 16. 67 |
| 1923 | 116, 565 | 14 | 12. 01 | 2 | 1. 72 | 14. 29 |
| 1924 | 119, 280 | 7 | 5. 87 | 0 | 0 | 0 |
| 1925 | 115, 391 | 4 | 3. 47 | 0 | 0 | 0 |
| 1926 | 113, 756 | 4 | 3. 52 | 0 | 0 | 0 |

Compulsory inoculation against typhoid fever was begun in February, 1912. The Navy's vital statistics for typhoid fever were immediately and favorably influenced.

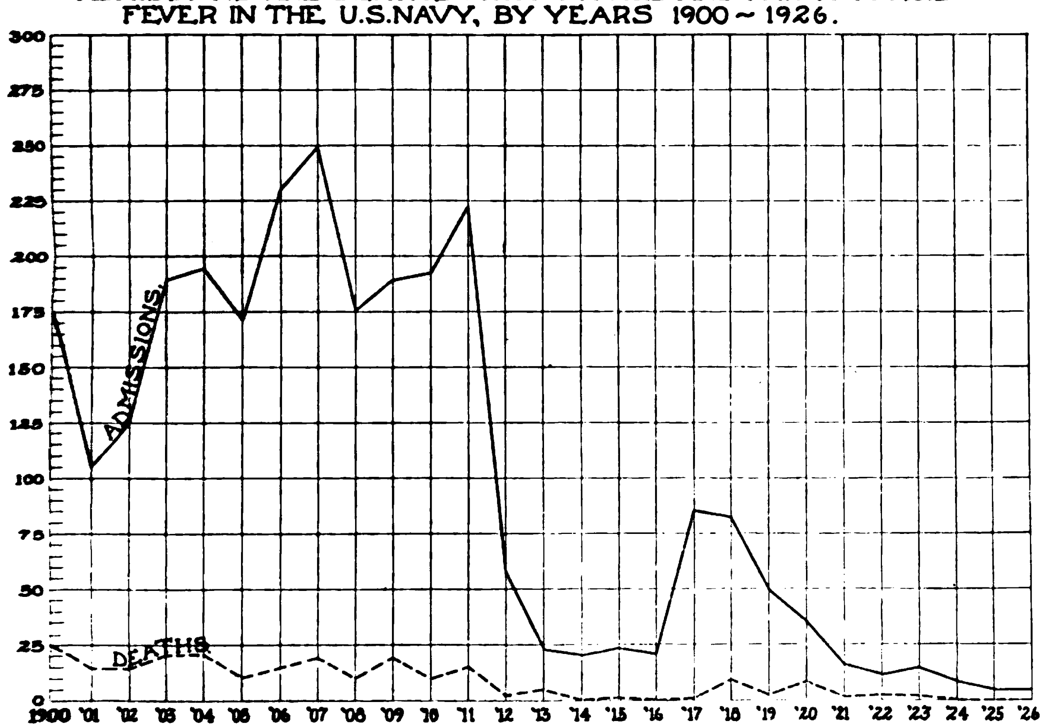
The graph shown indicates the number of admissions and deaths by years, with the decrease of each.

The rates for 1900–1911, inclusive, represent conditions "before taking" and the rates for 1912–1926, inclusive, those "after taking" the compulsory antityphoid inoculation.

It is felt that the rates for 1900–1911, inclusive, and those for 1912–1926, inclusive, may fairly be compared, and that allowing fully for the fallacies and pitfalls of dealing in statistics, it is justifiable to conclude that antityphoid inoculation has proved of definite value to the United States Navy.

The average age of the active officers, enlisted men, and midshipmen is 25.72 years. The average age upon first enlistment during

ADMISSIONS AND DEATHS FROM TYPHOID AND PARATYPHOID FEVER IN THE U.S.NAVY, BY YEARS 1900 ~ 1926.




the past fiscal year was 19.32 years. These figures indicate that most of the Navy personnel fall within the age group most susceptible to typhoid fever.

This personnel serves all over the world on our ships and at our shore stations.

Navy men serve on cruising ships, and, while living in as good sanitary conditions as ships afford, may encounter most unhygienic conditions when they go ashore for duty or recreation.

They are not continuously in one environment where they may become slowly immunized as a result of ingestion of small numbers of typhoid bacilli, raw or cooked, as result of pollution of food or water.

To-day they eat and drink in New York and a week hence they may be eating and drinking in Europe, the West Indies, Central or South America, or in some other port in the United States.

While their life aboard ship largely can be controlled from a sanitary viewpoint, the ingestion of food and drink is not so controllable when the men leave their ships.

Infallibility can not be claimed for antityphoid inoculation, nor can it be claimed that a permanent immunity is produced by it, but the experience of the United States Navy indicates that a definite immunity results from its use, and that the immunity fades out in about two years or possibly a little longer.

This belief is borne out by the outbreak of typhoid fever at Salem, Ohio, in 1920.

There were 882 cases among a population of 10,305. In the age group 20 to 30 years 1 woman in every 8 was attacked. In the same age group there were 210 ex-service men veterans of the World War.

These men had been compulsorily inoculated against typhoid fever while in the service of the United States, and although some of them had been inoculated three years prior to the outbreak in Salem, only three of these ex-service men were attacked by the disease.

Osler and McCrae[1] say, "Males and females are equally liable to the disease, but males are more frequently admitted into hospitals, 2.4 to 1 in our series."

There is some good reason why in the same epidemic in the same city in the same age group 1 woman in every 8 was attacked, while among 210 inoculated ex-service men only 1 man in 70 took the disease in mild form.

This is not accident.

It seems probable that the principal variable; viz, the administration of antityphoid inoculation, other conditions appearing reasonably constant, is responsible for the relatively much greater immunity among the inoculated ex-service men than among the uninoculated women of the same age group.

Apart from academic discussion as to whether there may have been errors of diagnosis; whether a mass immunity is being acquired by our population; whether the typhoid strains are becoming attenuated in virulency; whether more general knowledge of health matters, better sanitary conditions, purer food, milk, and water are partly responsible, the outstanding fact remains that these various factors, plus antityphoid inoculation, appear to have prevented the outbreak and spread of typhoid fever which formerly occurred among the highly susceptible age group composing the major portion of the naval personnel.

[1] Osler, W., and McCrae, T.: The Principles and Practice of Medicine, tenth edition. New York, D. Appleton & Co., p. 3, 1925.

Paratyphoid fever must enter into any discussion of statistics concerning typhoid fever, because the diseases caused by *B. paratyphosus* "A" and "B" and the disease caused by *B. typhosus* have been confused clinically at times.

These diseases can not be differentiated without laboratory facilities.

The Surgeon General of the United States Navy[3] says, "From all the evidence available the expectancy seems to be that not much more than 10 per cent of cases having the clinical characteristics of typhoid fever are caused by paratyphoid bacilli." Hence not more than 1 per cent of error due to confusion of typhoid and paratyphoid fevers in absence of laboratory facilities may be regarded as probable in the foregoing table.

' Vaccine prepared at the United States Army Medical School has been used almost exclusively in the Navy. In 1917, when strains of paratyphoid "A" and paratyphoid "B" bacilli were added to the Army vaccine, the Navy also began to use triple vaccine. Triple vaccine was first issued to the naval service during the summer of 1917.

"The Navy discontinued the use of the triple vaccine November 5, 1924. Since then a vaccine containing approximately 1,000,000,000 typhoid bacilli to the cubic centimeter has been furnished."

The use of the triple vaccine was discontinued in the Navy because of (1) severe reactions caused by the inclusion in the vaccine of the paratyphoid strains; (2) paucity of paratyphoid cases notified in the Navy; and (3) the probable difficulty of immunizing against the strains of paratyphoid bacilli.

During the two years which have elapsed since the discontinuance of the use of the triple vaccine only two cases of paratyphoid fever have been reported for the Navy.

The vaccine containing typhoid bacilli alone has been continued since 1924 with results shown for the years 1925 and 1926 in the table above.

It would be absurd to claim that antityphoid inoculations alone are responsible for the present low morbidity and mortality rates for typhoid fever in the Navy.

However, without antityphoid inoculations the Navy experienced typhoid epidemics. With the inoculations the spread of typhoid fever in the Navy ceased.

The disease is no longer a serious consideration in the vital statistics of the United States Navy.

The following experience of the Medical Department of the Navy in one of our colonies is of interest in this connection.

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[3] Annual Report of the Surgeon General, United States Navy, 1926, Government Printing Office, Washington, p. 140.

Peterson[3] reports an outbreak of typhoid fever at St. Thomas, in the Virgin Islands, in 1918, in which there were 46 cases among the natives.

These natives, while not in the United States naval service, have depended upon the United States Navy for government and supervision of their public health since the purchase, in 1917, of these islands from Denmark by the United States.

The census of 1917 showed 6,999 persons between the ages of 5 and 45 years, and compulsory antityphoid vaccination of this age group was begun on August 5, 1918, because of the spread of typhoid fever.

From the time of completion of this general vaccination typhoid fever began to disappear.

Hakansson[4] says of typhoid fever, "It ceased to be a disease of the Virgin Islands in 1918, when the population was immunized against the disease and when the removal of human excreta came under control of the health department.

(It is needless to say that every practicable precautionary measure was taken in addition to the vaccination.)

"The typhoid death rate in the Virgin Islands previous to 1919 was a factor of grave importance. The annual average recorded for St. Thomas-St. John, 1909–1918, may be seen to be 37.7 per 100,000 population. It is probable, however, that this was actually twice as high. Many fatal cases of typhoid fever were never diagnosed as such, due to the lack of laboratory facilities *before United States purchased the islands* (italics ours) and the inadequacy of the sanitation service; and other deaths were certified by 'Corpse inspectors' to be due to 'fever,' 'diarrhea,' and other ill-defined diseases."

The Annual Report of the Surgeon General of the United States Navy for 1923 says, "Typhoid fever, which formerly was very prevalent in the Virgin Islands, has been abolished by requiring all persons residing in the islands between the ages of 5 and 45 to be inocculated with antityphoid vaccine." Lieut. Commander John Harper, Marine Corps, United States Navy, who was in charge of the municipal hospital at St. Thomas, and Chief Pharmacist's Mate W. F. St. Clair, United States Navy, who served as sanitary inspector have stated to me that no typhoid fever was seen there up to January 1, 1927, except one case brought ashore for treatment from a ship making St. Thomas a port of call. The United States Public

[3] Peterson, E., Infectious and Contagious Diseases in the Islands of St. Thomas and St. John, Virgin Islands of the United States, March–September, 1918, U. S. Naval Med. Bul., Vol. XIII, p. 682, 1918.

[4] Hakansson, E. G., Birth and Mortality Statistics of the Virgin Islands, 1901–1919. Government Printing Office, Washington, p. 31, 1920.

Health Service Reports for the years 1918–1926, inclusive, show no record of typhoid fever in the Virgin Islands except the one imported during October, 1926.

Here appears to be a triumph of prophylaxis. An epidemic of typhoid fever is stamped out and the disease has not reappeared among a native population whose facilities for sewage disposal are primitive in most cases, and whose instruction in hygienic living has been most meager.

The preventive measures previously taken plus antityphoid inoculation stamped out the disease.

In studying the above table, which shows the morbidity and mortality rates for typhoid fever in the Navy, the gradual reduction of the same rates in large cities of our country must be remembered.

But with the experience of the Navy, as shown by the above table; with the evidence of immunity conferred, as shown by the report of the Salem, Ohio, epidemic; and by the record of the Medical Department of the Navy in the Virgin Islands before us, and with the record of typhoid prevention in the Army, as well, should not we, as physicians, urge the more general employment of antityphoid inoculation?

If an epidemic like Montreal is experiencing can be prevented, why not do so?

Montreal can not reasonably be accused of being a backward community, lacking in knowledge of and facilities for hygienic and sanitary living.

Montreal's sad plight might be that of any well sanitated city in our own country if a general food or water pollution should occur in the supply distributed to that city.

The population is not immunized. Accident to food or water supply may cause disaster. Antityphoid inoculation confers immunity. Are we not remiss if compulsory antityphoid inoculation is not required in communities where typhoid fever is endemic?

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## AVIATION CRASHES AT PENSACOLA—1927

By J. D. Benjamin, Lieutenant, Medical Corps, United States Navy

Each year more and more statistics become available regarding aviation crashes. These make easy the comparison of the relative safety of flying in one year as compared with other years. Flying is safer now, without a doubt. The public interest in aeronautics proves this. Not long ago a certain civilian flying field held a bargain day on which the price of flights was reduced, and the field was crowded with people eager and anxious to go up in a plane. Old people, and it

is well known that people become more conservative as they grow older, are asking to go into the air. Recently the papers published the picture of a woman supposed to be 100 years old who had taken her first flight. Henry Ford, a conservative and rather elderly man, took his first flight not long ago. True, he flew with Lindbergh, but, nevertheless, he flew.

For the past two years it has been the custom at the Naval Air Station, Pensacola, Fla., to review the flying for the previous year and analyze the figures so obtained in order to gain therefrom some useful facts. These articles have been published in the U. S. NAVAL MEDICAL BULLETIN each year. (*See* U. S. NAVAL MEDICAL BULLETIN, 24; 1; p. 72 and. U. S. NAVAL MEDICAL BULLETIN, 25; 1; p. 86.) This year an attempt has been made to do the same. In previous years the factors of the age of pilots, seasons, and causes of crashes were considered. Nothing further will be said as to the age of the pilots, although it is believed that the younger pilots have a better chance than the older ones. Youth must be served. The season of crashes and the cause of crashes are considered here, as well as the types of planes that crash most often. The type of student that does the best in training is also discussed. If one can learn by compiling figures where mistakes have been made in the past, then it is often possible to correct them. If statistics will save one life, then they have well been worth while. Too much dependence must not be placed on figures. They have only a relative importance. Too often, actual facts which do not appear along with the figures have a bearing on the figures that greatly affect their meaning. Oftentimes they are not entirely accurate, so they must be taken with a grain of salt.

During the fiscal year 1927—that is, from July 1, 1926, to June 30, 1927—there were 35,102 flights made on this station, with a total of 29,648 flying hours. Sixteen different types of planes were used in making these flights, so the flying was diversified in nature. It comprised seaplane as well as land plane flying. The total number of miles flown at 70 miles an hour equaled 2,077,915. During the year there were 26 crashes. This makes 1 crash out of every 1,350 flights, or 1 crash in 1,140 hours of flying. In these 26 crashes there were 5 deaths, those of 2 students, 1 aviation pilot, and 2 passengers. Considering the number of flights and hours of flying, this shows that there was 1 death for every 5,929 hours of flying, or 1 death in 7,020 flights. There were 7 minor injuries and no major injuries. If the number of students and the number of hours flown are considered, it will be seen that there was 1 death of a student for every 12,688 hours of training flying. There were also 29 forced landings during this time.

In the three years from July 1, 1922, to June 30, 1925, there were 90 crashes in 52,584 hours of flying at this station, making 1 crash in

every 584 hours of flying. There were 12 deaths, or 1 death in every 4,382 hours of flying. From July 1, 1925, until June 30, 1926, there were 40 crashes in 26,263 flying hours, or 1 crash in every 656 hours of flying. There was 1 death during that time, or 1 death in 26,263 hours of flying. Adding the figures for these four years to those given above for the year ending June 30, 1927, makes a grand total of 108,495 hours of flying for the five years, with a total of 156 crashes. This is eqivalent to 1 crash in 696 hours of flying. There were 18 deaths during this period, or 1 death in every 6,027 flying hours. Considering the fact that in the year ending June 30, 1927, there was 1 crash in every 1,140 hours of flying, it can be seen that there has been a progressive improvement in the safety of flying, as the ratio for the past year is considerably under the ratio for the total of the five years. The number of deaths in proportion to the hours of flying for the past year averages about the same as that for the total of the five years, there having been during these years 1 death in every 6,027 hours, while for the year ending June 30, 1927, there was 1 death for every 5,929 hours of flying.

Aside from the fatal cases there were, as has been stated before, 7 cases of minor injuries, as follows: 4 lacerations, not of a serious nature; 1 Colles's fracture; 1 contusion; and 1 concussion and abrasion. All of these patients went back to duty in a fairly short space of time.

The causes of crashes listed on the form sent out by squadron commanders immediately after crashes occurred showed the pilot to be the main offender, as has been the experience in the past. Inexperience is the cause assigned in 15 out of 26 crashes. Considered on a percentage basis, this is about 57 per cent. Other causes assigned to crashes were as follows: Unknown, hole in pontoon, broken fuselage, landing gear gave way, bad weather. Probably the crashes listed under "unknown" and "bad weather" were really, in a majority of cases, due to the pilot, as an experienced pilot will usually make out all right in bad weather or will land before the storm strikes him.

There seems to be considerable difference of opinion as to what constitutes a crash in the strictest sense of the word as it pertains to aviation. Webster defines a crash as follows: "*Verb.*—To break or dash in pieces violently and noisily; to smash; to shatter. *Noun.*—A breaking to pieces by violent collision." Unfortunately, Webster never heard of aviation, so it is impossible to look for a definition of aviation crashes in his dictionary. Naval Medicine and Surgery Form No. 1 defines crashes as follows: "Any accident resulting in injury to pilot or passenger, or any material damage to plane occurring from onset to end of flight, will be reported by the flight surgeon as a crash." The timekeepers on aviation stations count flying time

from the time a plane leaves the ground or water and goes into the air until it lands on the ground or water again. If a plane crashes while taxiing on the ground or water, never having gotten into the air, can it be called a crash? There would have been no flight, but the plane may have been injured. According to the above definition, if there has not been a flight there could not be a crash. If a plane struck a log while taxiing across the bay preparatory to a flight and sank, would that be a crash? It appears that the entire matter hinges on what constitutes a flight. That there is a difference of opinion as to what is a crash is shown by the fact that the operations office in charge of flying listed only 26 crashes, while on file in the dispensary are definite records, with crash reports made out by the squadron commanders, of 30 crashes for the same period, and there is one crash not recorded. Four of the reports of crashes on file in the dispensary probably appear on the station file as "forced landings."

Does the kind of plane have anything to do with the number of crashes? Probably it does. At any rate, there were nearly three times as many crashes in land planes as in seaplanes. This is probably explained in several ways. First, there were more flights made by land planes than there were in seaplanes; second, a new student flying over water always has a landing field under him, while, if he is flying over land and is away from the station field, he is not so sure where he may land and because of inexperience and lack of knowledge of the terrain over which he is flying is more than apt to pick out a poor or uncertain field and so either smash his landing gear or crack up entirely; third, water in any inclosed body, such as landlocked bay, is apt to be smoother than any field except a carefully kept flying field.

Some types of planes seem to be more prone to crash than others. This may be due to the fact that they are flown more or perhaps are used more frequently for training, and hence are flown more often by inexperienced pilots who are more prone to crash than experienced ones, or it may be that certain planes are easier to fly and handle better, hence the pilots take greater chances in them; that is, more stunting, more hazardous positions in flying. More crashes took place in JN and NY types, next in the N-9 type, and least in the T-3-M, NB, and VE types. From sources of information that seem accurate it appears the N-9 type has been declared obsolete and will not be used for training purposes any more. However, the N-9 has served its purpose well and has given great satisfaction in the past as a training plane. In fact, it has taken 11 years for it to be superseded by another plane for training.

Either the physical examinations are becoming stricter or the system of checking the students is more severe, or else the type of

student undergoing instruction is not so good as heretofore, because the percentage of those finishing instruction is steadily decreasing. During the fiscal year 1923, there were 111 students entered in instruction in flying and of these 66 finished; that is, qualified as pilots and received their wings. In the year 1924, there were 95 students under instruction and 68 finished. In 1925, 176 started and 87 finished. In 1926, a total of 145 students began and 77 were present at the end. During the fiscal year 1927, only 66 students finished out of 186 who began training. This is partly explained by the fact that at the beginning of the year there were still remaining from previous classes 69 students who had not completed the course. Other classes were formed later, making a total of 158 officers and 112 enlisted men, altogether 270 students, in training for flying during the year 1927. Of these, 38 officers and 43 enlisted men were left at the end of the fiscal year and carried on into the fiscal year 1928. These people were still under instruction. Forty-nine officers and 17 enlisted men completed the course; that is, a total of 66. These figures become more remarkable when they are considered on a percentage basis. In 1923, a total of 66 out of 111 equals 59.5 per cent. In 1924, 68 out of 95, or 71.5 per cent, completed the course. In 1925, 87 out of 176, or 55 per cent, finished. In 1926, those completing the course numbered 77 out of 145, or 53 per cent. In 1927, there were 66 successful out of 186 students. This equals 35.5 per cent. If the total for the entire five years is considered, it will be seen that 713 students started training and 364 finished, making a total percentage of 51 finishing. That is considerably more than the percentage for 1927, when only 35.5 per cent finished, and shows a marked difference from the figures for the year 1924, when 71.5 per cent finished. What is the answer? Is it because a large percentage of the class were enlisted men? There were 189 students under instruction, of whom 69, or 36.5 per cent, were enlisted men. It seems that there is some basis for the opinion that the increased number of enlisted men undergoing training has some effect upon these figures, as 49 officers out of 120, or 40 per cent, finished, while only 17 enlisted men out of 69 that started, or 25.5 per cent, completed the course. It is, of course, a fact that an officer has a tremendous advantage over an enlisted man when he starts instruction, as he has better preliminary education and has had instruction in many of the subjects related to aviation. Officers too, are as a rule, of a higher type mentally than enlisted men. All of these things must be considered advantageous if it is considered that psychology is so important a factor in aviation as one is taught to believe it is. Enlisted pilots have a place in squadrons that is hard to fill, in the opinion of many squadron commanders, and years of

flying, with the incidental experiences accompanying it, develop many enlisted pilots into crack flyers. Hence, they should continue to be trained.

Seasonal influence on flying, and the time of the year when most crashes occur, have often been discussed. The consensus of opinion is that the time of the year does not have a great deal to do with crashes, except that in very bad weather it is best not to do too much flying and to pick the days for it. The wintertime, when most of the bad weather occurs, causes flying activities to be somewhat curtailed, while in the months when there is better weather there is more flying, so that the old law of averages evens things up somewhat. When there is more flying, more crashes are likely to occur. During the three-year period from July 1, 1922, to June 30, 1925, more crashes occurred in August and September and the smallest number in November and December. From July 1, 1925, to June 30, 1926, more crashes occurred during April and June, while the least number occurred in February. During the past year there were more in November than any other month, and none in February and June. So it seems that February is the safest month, probably because it is a short month and two holidays come during it, and because, at that season of the year, there are likely to be fewer flying days.

## Summary

It appears that aviation is steadily growing safer. Figures definitely prove this fact. There is no class of people more prone to crash than aviation students, so any figures which show that flying among students undergoing training to become aviators is safer, also prove that aviation as a whole is safer. During the past year, at this station, there was one crash in 1,140 hours of flying, as compared with one crash in 584 hours of flying during the three-year period ending in 1925. In other words, flying has become practically 50 per cent safer two years later. February continues to be the safest month. Officers seem to have a better chance of qualifying as pilots, although there are too few data to enable one to form any definite conclusion on that point. When a plane crashes now it appears to be either safe or fatal for the pilot and passengers, there does not seem to be any "in between." The cases of serious injury that lingered on and made the patient suffer for indefinite periods, such as formerly occurred, do not seem to be associated with aviation accident nowadays. This conclusion is reached from the fact that in 26 crashes five people were killed and only seven were injured, and none of these injuries was serious. In most of the crashes the occupants got out of the planes and walked away unharmed. The

pilot is still the chief offender as to the cause of crashes. In 15 out of 26 crashes inexperience was given as the cause. That, of course, means the pilot is at fault.

## EYE EXAMINATION AS A FACTOR IN THE REDUCTION OF INDUSTRIAL ACCIDENTS

By J. W. Brewster, Lieutenant, Medical Corps, United States Navy

The office of Medical Assistant to the Safety Engineer was created in July of 1922, pursuant to an order issued by the Secretary of the Navy. His duties were stipulated as follows:

Make weekly inspections of all ships, storehouses, buildings, outside yard spaces, and compartments aboard ships where work is in progress, occupied or used by civilian employees. This inspection will cover all conditions that might be a possible cause of injury or disease from the point of view of situation, sanitation, heating, lighting, ventilation, and improper use of tools or appliances from a medical standpoint.

Make weekly written report to the safety engineer as to the completion of the above inspection, noting any defects discovered, including recommendation for correction.

Carry out campaign of education of all civilian employees on matters mentioned above as to the benefits to be obtained from proper observance of correct personal hygiene and habits, obedience to the laws of nature, and also as to the desirability of pertinent suggestions from all civilian employees regarding improvements in these matters.

Supervise preparation of daily accident record, monthly accident reports, and proper use of the injury report slip.

During the succeeding 12 months following the above instructions, important statistical data were collected relating to the causes, types, and nature of accidents occuring in navy yards, and an avenue was opened for their better control and prevention. From an analysis of these data the Navy Department evolved a system of recording accidents that permitted a more accurate placing of the responsibility and gave an index for measuring the success of preventive measures taken.

Accidents were then recorded under the following classification: (*a*) "Safety lacking," comprising those accidents due to faulty condition or lack of safety devices, including protective clothing and goggles, or lack of safety operating instructions. (*b*) "Failure of employee," comprising those accidents due to the failure of the employee or his fellow worker to use or wear the mechanical or protective devices furnished, or direct violation of prescribed safety rules of operation. (*c*) "Unsafe practices," comprising those accidents due to unsafe practices or carelessness on the part of the injured or his fellow worker, including horseplay, skylarking, carelessness in securing and stowing, or leaving articles lying about,

and failure to use ordinary precautions when safety appliances can not be provided or fitted on account of the nature of the work. (*d*) "Unavoidable," comprising those accidents which would not be prevented by safety devices of one kind or another or by safe practices on the part of the injured employee or his fellow worker, such as injuries to the eyes from particles in the air, not directly ascribable to some machinery or operation.

Study of those accidents recorded under the heading of "Safety lacking" speedily brought about the installation of all manner of safety devices, from guard rails and cages to gas masks, with detailed instructions for operation, so that the machinery and its operation have become nearly "foolproof."

It soon became apparent that the largest field for medical endeavor was in the study of the other three groups. With this in mind, and as a further effort to reduce the number of accidents, the commandant conceived the idea of according to all civilian yard workmen who felt that their vision was defective or whose quality of work or manner of working suggested that they suffered from defective vision, the privilege of an eye examination. For this purpose this dispensary was very fortunate in securing the services of Dr. D. A. Heffernan, acting assistant surgeon in the Navy, and attached to the naval hospital in Chelsea, in the capacity of eye specialist. He made arrangements with optical firms for a reduced rate of charge for the glasses that he prescribed. A number of circular letters were issued, beginning early in January, 1926, designed to educate the workmen to the point of believing in the expediency of the proposition. It was a voluntary act on the part of the employees and applications were forwarded to the manager of the yard.

The examinations were begun in February, and it was found that from 25 to 30 men could be examined in a day. Those with good vision as determined by the Snelling's card test and in reading ordinary print were dismissed. Those having defective vision were listed to appear later as summoned. A total of 707 examinations were made during the ensuing months. Of this number, 405 were summoned for reexamination and 322 were found to require glasses. Eight men were discovered with conditions indicating specific and other treatment and were referred to civilian hospitals for treatment. The workmen were generally very appreciative of the privilege of having the examination made.

The publicity of the campaign and the fact that the men themselves were individually taking an active part in a measure for safety increased their morale and this, in itself, largely repaid the effort. However, a concrete testimonial in the form of statistics

is far more convincing although less readily demonstrated. Despite the fact that there was an increase of 30 per cent in the number of men employed in the 12 months following the institution of the examinations over the preceding 12 months, the number of accidents due to the "Failure of the Employee" was decreased. From a total of 156 accidents, with 213 days lost from work in the preceding 12 months, there was a reduction to 43 accidents with 18 days lost. There was an increase in the number of accidents due to "Unsafe Practices" and those termed "Unavoidable," but even with this there was little increase in the totals of time lost in days. This was to be expected, as the 30 per cent increase in the number of men employed was made up almost entirely of shippers and calkers, drillers, and welders, for work on the reconstruction of the *Florida* and *Utah*, in which trades the minor accident hazards are greatly increased over those in the other trades. The results appear meager for the effort expended, but any reduction in the number of accidents is worth while now that the field for further improvement has been narrowed down largely to the human operator with his frailties and capacity for error.

## CLINICAL NOTES

### SARCOMA OF FEMUR

By P. F. DICKENS, Lieutenant, Medical Corps, United States Navy, and G. G. HERMAN, Lieutenant, Medical Corps, United States Navy

#### REPORT OF CASE

Those tumors of connective tissue type, composed of cells of varied size and shape, with well developed cytoplasm and less conspicuous basement substance than adult connective tissue, and having the power of invading and actively destroying adjacent structures, and whose cells always stand in an intimate relationship to the basement substance, are typical of sarcoma. This is the pathological picture of sarcoma, but, on examining a patient, this information is of little value at that time to the clinician in making his diagnosis. Sarcomata of bone are common, deserve careful consideration and study, and should be looked for whenever any patient presents himself for examination. If found early, a mutilating operation may be prevented and the patient saved much pain, and even his life may be prolonged. If current literature is to be relied upon, there are several points which should be considered in making the diagnosis of sarcoma of bone. Meyerding (1) states that by correlation of the röntgenographic findings with the history and the clinical findings, a correct diagnosis of malignancy can be made in a large percentage of cases of long bones without surgical interference. Before sacrificing a useful limb by amputation it is advisable to perform a biopsy and obtain the pathologist's opinion. This author contends that, although it is usually possible to diagnose sarcoma of the long bones from the röntgenogram, one should take into consideration the history, clincal, and laboratory findings. MacGuire and McWhorter (2) believe that one should be able to make a correct diagnosis of sarcoma in all cases and that the type can be distinguished in about 90 per cent of the cases from a study of the clinical, röntgen-ray and pathologic findings. Bloodgood (3) states that when a palpable mass is distinctly situated on the shaft of a bone, like an exostosis, and when the röntgenogram shows that new bone is resting on the shaft, it must be borne in mind that trauma, infections, and neoplasms may all produce an ossifying periosteal growth with or with-

out any visible changes in the shaft. In connection with the above statement of Bloodgood the reader is referred to Figure 1. Bloodgood in the same article states that when the röntgenogram shows a diffuse lesion resembling, for example, a sclerosing sarcoma, it must be borne in mind that a nonsuppurating osteomyelitis may somewhat resemble sclerosing sarcoma. In both there is evidence of new bone in the involved area, and, as a rule, the dark areas of ossification predominate in the röntgenogram. Jepson, in abstracting an article by Meyerding, states that the periosteal type appears to involve only one side of the bone and is apparently unable to form bone. (See Figure 2.) One should not forget that benign tumors of bone exist, and Bloodgood aptly draws attention to this fact. This author states that all connective tissue tumors arising from the soft parts and bone in the region of the phalanges of the fingers and toes are benign.

## Biopsy

When to perform an operation to obtain a piece of tissue for pathological study is a problem often confronting the surgeon. After reviewing the literature, and from our own experience, we believe that when the question of malignancy arises the surgeon is not justified in doing a biopsy unless he is able to receive a pathological report from a competent pathologist within a few days, and also has previously received permission from the patient to amputate the limb should the diagnosis of malignancy be confirmed. It will be interesting to follow the case reported here, in view of the fact that weeks elapsed between the biopsy and the amputation. Bloodgood has reported a case of periosteal sarcoma with a seven-year cure following amputation, in which there was an interval of about two weeks between the biopsy and the amputation. It seems to be the consensus of opinion that it is better surgical judgment to obtain a piece of the tissue for pathological study before amputation.

## Etiology

The cause is unknown. The specific cause theory is not yet proved. Some authors assign traumatic injury as a cause, but if one could eliminate those cases in which sarcoma existed prior to injury it is believed that trauma would not be considered as a factor of great importance.

## Treatment

Shall the treatment of a given bone tumor be amputation, radium, or X ray? Unless the type of bone tumor be known, the best method of approach in treatment is not known. The method of treating periosteal tumors and other lesions of bone are different. The loca-

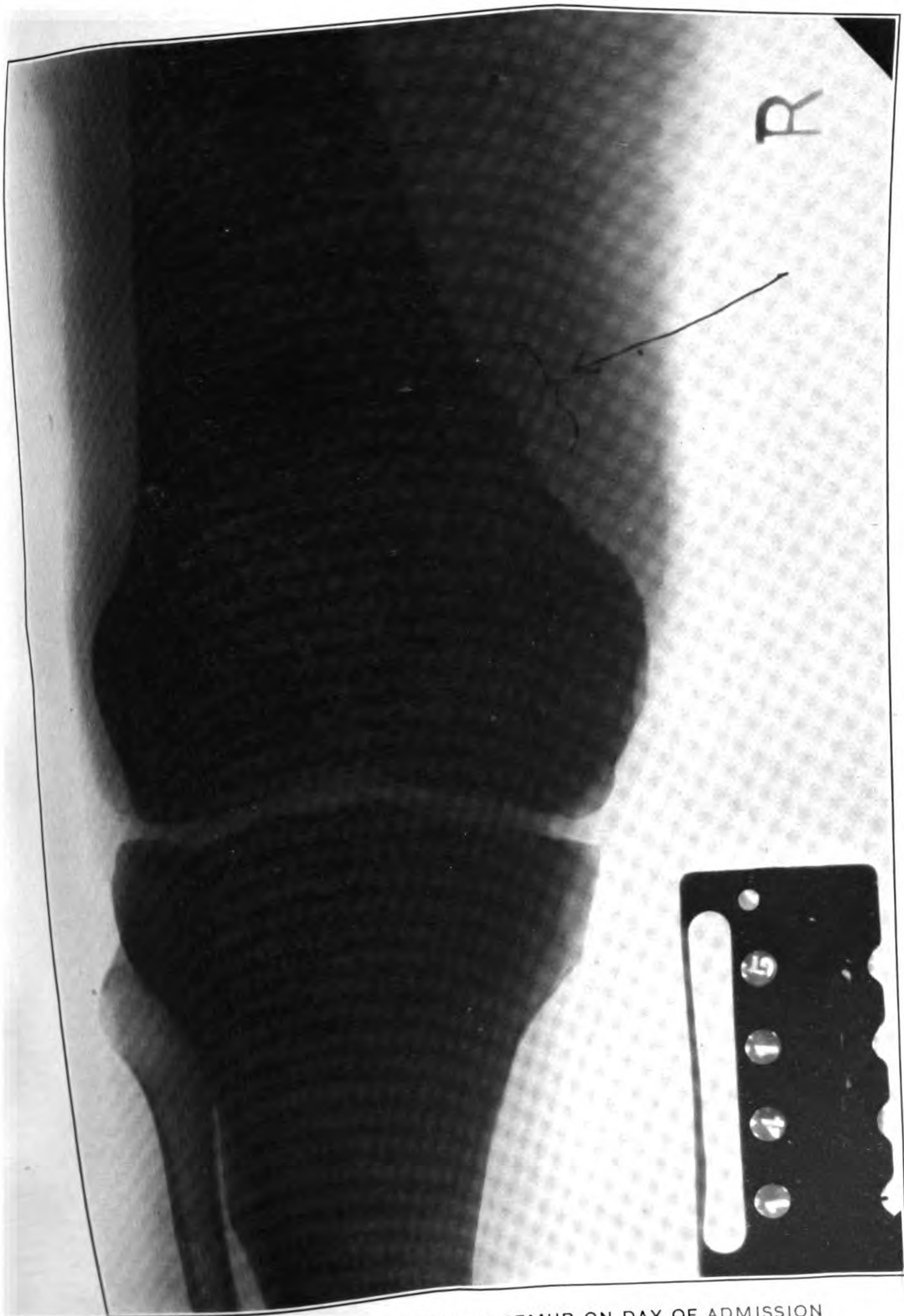


FIG. 1.—RÖNTGENOGRAM OF FEMUR ON DAY OF ADMISSION

74—1

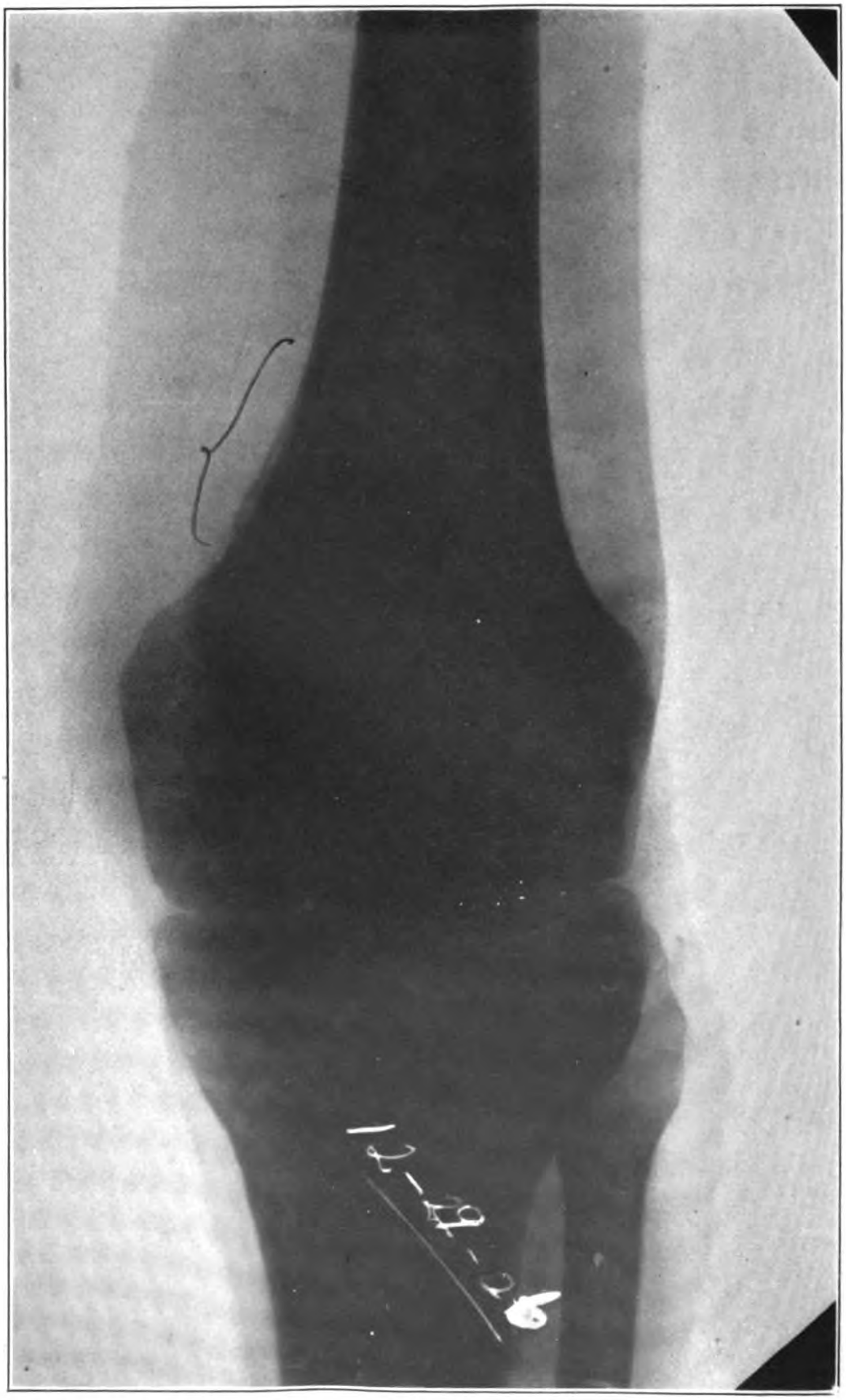


FIG. 2.—FEMUR 20 DAYS BEFORE OPERATION. ON DAY OF OPERATION CONDITION WAS THE SAME

74—2

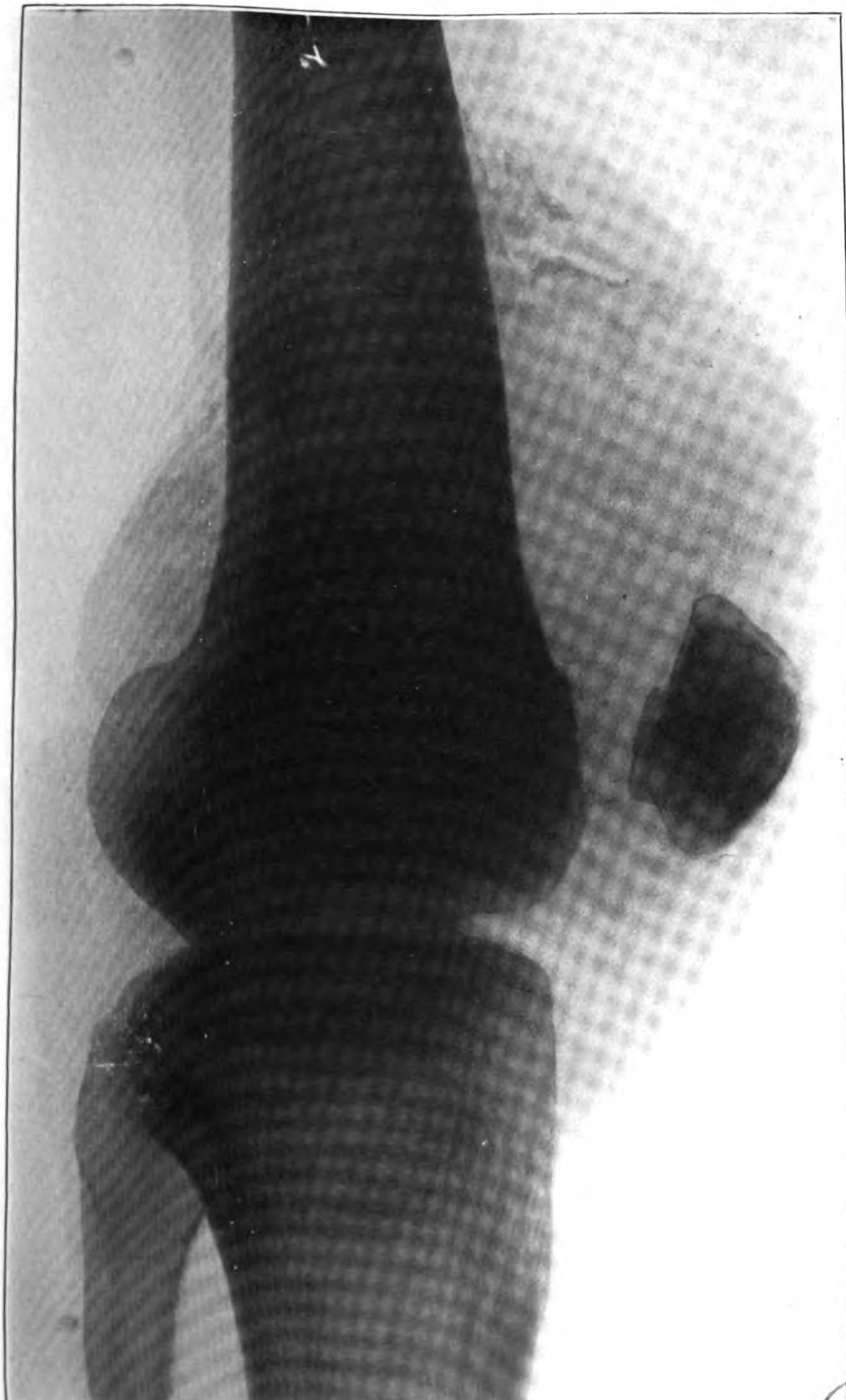

FIG. 3.—FEMUR 23 DAYS AFTER OPERATION. LATERAL VIEW. NOTE RAPID GROWTH OF TUMOR MASS

74—3

FIG. 4.—FEMUR 23 DAYS AFTER OPERATION. ANTERO-POSTERIOR VIEW

74—4

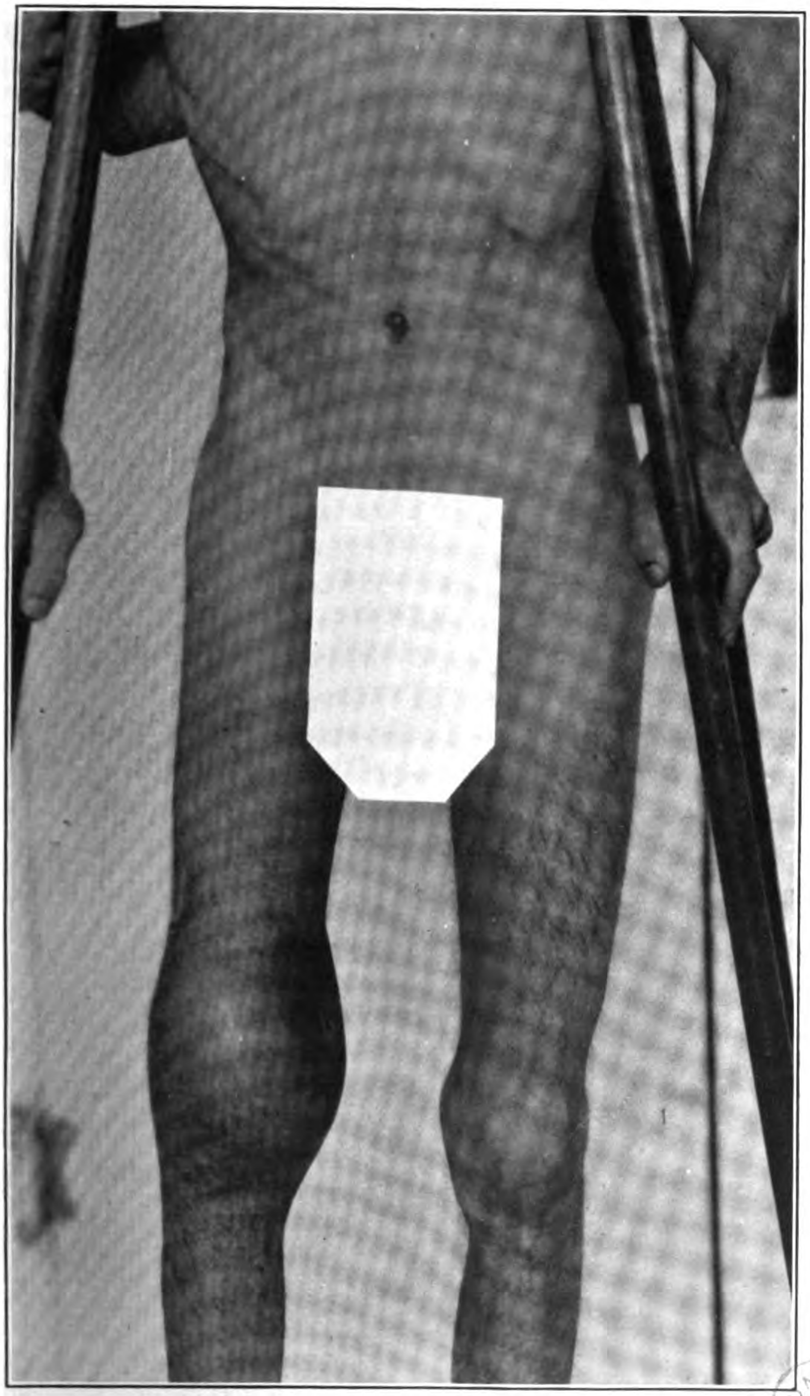

FIG. 5.—SWELLING OVER TUMOR MASS ONE MONTH AFTER OPERATION

74—5

tion of the lesion and extent of involvement, and the question of metastases already having taken place, all enter the question of appropriate treatment. The presence or absence of a positive blood serum must be considered. In this connection it is noted that in an abstract of an article of Bloodgood's by Rich in Surgery, Gynecology, and Obstetrics, volume 19, the following appears: "In the past 10 years there has been no bone lesion with a negative Wassermann reaction that was benefited by intravenous therapy." Bloodgood has noted also that there is not a single recorded case of sarcoma of bone in which the Wassermann reaction was positive, nor one associated with active tuberculosis of the lung, nor one in which there has been a recent and definite focus of infection. The treatment of central tumors, where bone cyst has been excluded, is complete eradication of tumor tissue by thermal and chemical cauterization followed by radiation. Giant cell tumors should be treated by radium or X ray. Periosteal and diffuse lesions of the extremities should be treated by amputation. Coley's fluid was tried by one of us (P. F. D.), with no apparent benefit to the patient. The main point in the treatment of bone sarcoma seems to be the selection of the proper cases for irradiation and those where obviously operation is indicated; conversely, the danger is of radiating those cases where operation is indicated and the pushing of radiation too far in cases of central lesions.

### CASE REPORT

F. B., private, first class, United States Marine Corps, admitted to this hospital on November 2, 1926, with the diagnosis of sprain of right knee. Origin duty. Family history negative for tuberculosis, malignancy, and insanity.

*Past history*.—Mumps and measles during childhood. Denies venereal disease. In October, 1923, while playing football, patient received an injury to the right knee which produced pain and swelling and this lasted for a period of four days.

*Present illness*.—On October 16, 1926, while playing football, patient injured right knee and it was painful to walk and there was slight swelling. The pain subsided, but some swelling remained until his admission on November 2, 1926.

*Chief complaint* is pain and swelling of right knee.

*Examination* shows well nourished, well muscled individual, with normal temperature, pulse, and respiration. Ears show some structural deformity. No gross structural defects present. Eyes, nose, and throat, normal. Heart, lungs, and abdomen fail to reveal any pathology. There is a slight swelling of soft tissues of knee, somewhat more pronounced over internal condyle of femur. No redness nor fluctuation apparent. Movements are painful, but otherwise not impaired. Patient walks with a limp. Inguinal glands, both sides, enlarged. Epitrochlears, palpable. No evidence of ulcers or scars on external genitala. Urine, negative for sugar or albumin. X-ray examination of knee is negative for fracture, dislocation, or joint involvement. There appears to be a lifting of the periosteum or a periosteal defect on the proximal third of the supracondylar ridge of the femur, just above the inner tuberosity.

November 6, 1926.—Temperature, pulse, and respiration remain normal. No changes in swelling of right knee.

*Kahn blood serum reaction negative.*—Plaster cast applied to right leg and thigh.

November 18, 1926.—Rise of temperature in evening to 99. Pulse and respiration normal. Patient has good appetite and sleeps well.

November 20, 1926.—Cast removed, swelling somewhat diminished. Patient complains of pain in knee. Continues to show evening rise of temperature with return to normal in morning. Swelling of knee remains unchanged, and there is tenderness with some redness over internal condyle where the swelling is most pronounced. No change in knee demonstrated by X ray. Light therapy instituted.

December 4, 1926.—Continues to run slight evening rise in temperature. X-ray examination of chest shows slight thickening at either root, otherwise negative. White and differential blood counts have been within normal limits. Tonsils and teeth appear normal. No definite foci of infection found.

December 15, 1926.—Continues to run slight evening temperature. No change in knee condition. Area over condyle needled, but no fluid or pus obtained. Sodium salicylate administered to physiological limit of tolerance

December 20, 1926.—Salicylate gave some relief from pain and tenderness, but no change in swelling around knee was noted. Skin is glossy and trophic changes apparent.

December 29, 1926.—Condition remains unchanged. Blood culture negative.' Sedimentation test suggests an arthritic condition. Knee joint aspirated. Small amount of clear, straw-colored fluid obtained.

January 2, 1927.—Continues to run evening temperature. Culture of synovial fluid negative. (No growth.) X ray shows some thickening of periosteum over lower portion of shaft of femur just above inner tuberosity. White and differential blood counts normal. X-ray films of teeth, normal.

January 9, 1927.—Continues evening temperature up to 100. Normal in morning. Pulse 80, respiration normal. Blood counts normal.

January 18, 1927.—X ray shows increased periosteal thickening on proximal third of supracondylar ridge. The distal third of supracondylar ridge shows a break of 1 inch in the periosteal line.

After consultation with other members of the staff of this hospital, a tentative diagnosis of a low-grade infectious process involving the periosteum was made and operation advised.

January 19, 1927.—Operation this date. Ether anesthesia. Incision over internal condyle. Tumor about the size of a small lemon removed. Tumor encapsulated, of a firm consistency, having the gross appearance of connective tissue. Tissue mass was friable and surrounded by an area of great vascularity. Right supracondylar ridge shows a new bone formation, which appears to communicate with tumor mass. New bone formation was removed, leaving grossly healthy bone. All tissues sent to pathologist. Wound left open, drainage instituted.

January 20, 1927.—Good recovery from ether anesthesia. Wound clean. Slight rise in temperature and pulse following operation.

January 29, 1927.—Wound remains clean. White and differential blood counts normal. Red blood count 4,600,000. Hemoglobin 95 per cent. Red cells have a normal appearance. Knee increasing in size. Wound clean. Sedimentation index, 34.5. Sediment time, 60 minutes. Free of pain except on movement of knee. There is considerable atrophy of thigh and leg, with increase in size of swelling.

February 13, 1927.—Knee rapidly increasing in size.

*X-ray report.*—There is a large, soft tumor encircling the lower end of the femur, containing considerable infiltrating and striated new bone formation.

The periosteum at the limits of the tumor is lifted and radiated over into the tumor. There is no destruction or involvement of the bone itself. (See Figures 3 and 4.)

*Histopathological report—Gross examination.*—Tissue is light-cream color to dark red, perhaps due to hemorrhage in tissue. Has consistency of cartilage in areas approaching bone. Cuts with great resistance. Tissue is very dense and granular to scraping with knife.

*Microscopical examination.*—Section shows quite a variety in appearance. Centrally, there is some recent hemorrhage. Surrounding this there is some old hemorrhage, which is disintegrating and being invaded by fibroblasts. Included in this hemorrhage is an area of tissue which is undergoing necrosis. The portion of tissue which stains well appears to be entirely new growth. The cells vary much in size, shape, and density of staining. The nuclei of most stain poorly and are granular. Clumping of nuclei is fairly common. Some of these cells are surrounded by an areola like osteoblasts. These cells are well separated and there is a deposition of a dense hyalinelike material which in places is calcified. Mitosis is fairly common.

*Pathological diagnosis.*—Sarcoma, osteogenic, femur. (See Figure 5.) No metastasis to lungs or elsewhere in body can be demonstrated by X ray.

Prior to operation the following symptoms were outstanding: Pain, tenderness, redness, and swelling of right knee, with evening rise of temperature, and the X-ray findings were those of a thickened and raised periosteum. The diagnosis of a low-grade infection involving the periosteum seemed warranted. This patient was transferred to the United States Naval Hospital, New York, N. Y., for radiation and operation.

The pathological study and report on the tissue in this case were made by Lieut. Comdr. Eben E. Smith, Medical Corps, United States Navy.

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## LEUKOCYTOSIS IN THE EARLY DIAGNOSIS OF CEREBROSPINAL FEVER

By. Paul Richmond, Jr., Lieutenant Commander, Medical Corps, United States Navy

During 1926 and part of 1927, 40 cases of cerebrospinal fever were treated at the United States Naval Hospital, Great Lakes, Ill. It was found that the benefit derived from the use of serum was much greater when it was given before clinical evidence of a meningitis was present. Four cases were thus definitely arrested after infection of the spinal fluid had taken place, as shown by cultures, and became convalescent in 24 hours without ever developing a meningitis.

Early intraspinal serum treatments were thought to have prevented infection of the spinal fluid from the blood stream in some of the cases in which blood cultures showed meningococci and spinal fluid cultures remained sterile. Although five cases of the septicemic type to whom no intraspinal treatments were given never progressed to a stage of meningitis, two were observed to develop meningeal infection after being given serum intramuscularly. All subsequent cases were given intraspinal as well as intramuscular serum injections as early as possible and none showed a meningeal infection unless it was already established at the time treatment was begun. No harm resulted in four cases which at first seemed doubtful enough to justify a spinal puncture but were shown later to be only catarrhal fever infections.

The earliest possible diagnosis is therefore important. Even three or four hours delay in starting treatment permitted cases to progress from symptoms resembling catarrhal fever to a comatose state. The earliest and most constant finding was a marked leukocytosis. A count of 50,000 per cubic millimeter with 98 per cent polymorphonuclears was found on the first day of the disease. Counts between 25,000 and 35,000 per cubic millimeters with 92 to 95 per cent polymorphonuclears were usual when clinical symptoms were yet indefinite. Several cases, which later proved to be meningococcus infections, had counts of over 20,000 per cubic millimeter when symptoms were slight and other methods of examination would not have differentiated them from the numerous catarrhal fever cases. Catarrhal fever, acute bronchitis, tonsillitis, laryngitis, and sinusitis cases encountered gave leukocyte counts uniformly below 20,000 during the first few days of illness. Occasionally an unexplained high count was found, but these did not constitute more than 1 per cent of all counts made during the epidemics. Pneumonias, empyemas, and peritonsillar abscesses were demonstrable when the leukocytosis was high enough to be confusing.

Most of the cases of cerebrospinal fever developed during the height of the catarrhal fever epidemics. Cultural methods of differentiation require too long an interval for an early diagnosis and are not usually possible aboard ship or at a naval station, but on all ships and stations leukocyte counts can be made without interfering greatly with the routine of sick call. Therefore, at the time of such epidemics, when cerebrospinal fever infections are also occurring epidemically or sporadically, it is believed that the most practical method of diagnosing these cases early is to have a leukocyte count made on all patients reporting at sick call with symptoms of catarrhal fever. Patients having counts of over 15,000 per cubic millimeter should be carefully examined for the typical eruption or some local-

ized disease, as acute sinusitis. Patients having counts of 20,000 or greater, without evidence of some local infection, should be considered suspects, isolated, and subjected to a spinal puncture with intraspinal serum treatment on the slightest additional evidence of a meningococcus infection. Where counts are around 30,000, with 95 per cent polymorphonuclears, unless pneumonia or some other sufficient cause can be demonstrated, it is believed that an immediate spinal puncture with serum treatment is justified, even in the absence of all other definite evidence of a meningococcus infection. To wait for a meningitis to develop is to permit the patient to pass into a critical state, from which even the serum treatment may not save him.

In meningococcus infections the leukocyte count was observed to increase as much as 10,000 per cubic millimeters in four hours; therefore counts should be repeated after a short interval on those near the arbitrary limits of 15,000 or 20,000.

## INFANT FEEDING IN THE TROPICS

By G. F. Cooper, Lieutenant, Medical Corps, United States Navy

The problem of feeding infants and small children in tropical and semitropical countries, presents many difficulties. This is especially so in a country such as Haiti, where it is next to impossible to obtain fresh cow's milk of good quality.

It therefore becomes necessary to depend on some of the prepared milk products, of which there are many. A few of these may be mentioned, such as Eagle Brand and Nestle's condensed milk, Dryco and Klim as powdered milks, and the various forms of malted milk and infant foods. Each of these is useful in certain cases, and many tasty combinations can be devised for older children.

Despite the widespread dislike of pediatricians for condensed milk, it is the opinion of the writer after 10 years of observation and trial, that babies do as well, or better, on condensed milk, than they do on cow's milk, if properly administered. After trying boiled Haitien cow's milk and all of the prepared foods mentioned for young infants, two types of formula stand out as most efficient for the maintenance of health and growth in a country such as Haiti. These are condensed milk and lactic-acid cow's milk. Of the two, the condensed milk is simple, easy to prepare, easily obtainable, and it produces results in the form of good health and development for the baby and mental relief for the parents—and physician.

Most mothers find that, even though they have sufficient milk of good quality, upon arrival of the baby, within a few weeks in the Tropics they become deficient either in quantity or quality, or both.

 

It then becomes necessary to devise some means of caring for the child's nutrition. A very simple scheme was tried by the writer, and after use on many babies, for over two years, it did not fail to give satisfactory results in a single case. It had been giving results to other doctors before the writer began its use.

### Formula for Condensed Milk Feedings

For this scheme of feeding, four articles are necessary, besides bottles and nipples. These are: condensed milk, oatmeal water, orange juice, and codliver oil. As the babies increase in age, canned spinach, tomato juice, and vegetables, as available, should be added to the diet. However, the most important necessity is food, for young infants from birth to three months or more of age, and the directions here are written with that thought in mind.

*Oatmeal water.*—Add 1 tablespoonful of flake oatmeal to 1 quart of water and boil for 45 minutes. Strain while hot through a cloth or fine wire tea strainer. When cool, this furnishes sufficient quantity for 24 hours and need not be kept on ice if placed away from possibility of contamination by ants, flies, or roaches, which are the bugbears of food supplies in the Tropics.

*Preparing the bottle.*—When ready to feed the baby, the amount of condensed milk desired (usually ¼ to ½ ounce for the first few days) is placed in a clean boiled bottle, and 4 ounces of the oatmeal water, previously prepared, are added. This proportion should be gradually increased each week or two weeks, depending upon the baby's general health and increase in weight, until 1 ounce of milk is being used. This latter amount seems to satisfy the requirements of growth and the baby's appetite, which are the two things of prime importance.

It becomes necessary to use common sense in that the baby, to be healthy and happy, must be satisfied after each feeding. Later, at about the end of the third or fourth month, it is usually necessary to increase the total amount of each feeding to 5 or 6 ounces, and the amount of milk to 1¼ or 1½ ounces. At the same time it may be necessary to increase the amount of oatmeal used in making the gruel to two tablespoonfuls, in order to keep the bowels in good condition.

*Number of feedings.*—From birth to the end of the first month, feedings should be given every three hours, at 6 and 9 a. m., noon, and 3, 6, and 9 p. m., with a possible night feeding the first few days at midnight, or 1 a. m. If the night feeding is necessary, it is easy to warm the oatmeal water and keep it in a thermos bottle at the proper temperature. This may also be done in the daytime if desired, instead of warming the gruel for each feeding.

After three weeks to one month, many babies will sleep from 6 p. m. to the first morning feeding at 5 or 6 a. m., thus eliminating the feedings at 9 and 12 p. m.

*Orange juice and cod-liver oil.*—Beginning the first week, the baby should have orange juice, 1 teaspoonful, diluted, daily, and ½ teaspoon of cod-liver oil, which may be given in two portions, if desired, one-half in the morning and the remainder in the evening. The oil and orange juice may be mixed, if better taken by the infant. Later, at about the second or third month the orange juice should be increased until the baby takes the juice of a whole orange daily and 1 teaspoonful of cod-liver oil.

*Attention to bowels.*—It will be found that in most cases the bowels will be regular and can be controlled by the amount of oatmeal in the oatmeal water. If they become free, the gruel may be made with 1 tablespoonful instead of 2. Later, when the oatmeal does not keep the bowels free, a teaspoonful of milk of magnesia added to one of the bottles will have the desired effect.

The stools at times have an offensive odor, but this is a natural thing with condensed milk and may be disregarded as long as the stools have a good consistency and color.

*Weighing the baby.*—The baby should be weighed weekly and given fresh air and a short sun bath daily. With common sense, most babies will thrive on such a routine.

*Abdominal bands.*—Babies should wear a light flannel band from birth on, and keep it on for at least the first two years, if in the Tropics. Very often it will be found that the young child develops diarrhea when the band is removed, and that the condition can be checked by replacing the band.

Babies should be given plenty of strained boiled water. All things being considered, with a little care, infants can be raised in the Tropics just as easily as in more temperate climates. If care is taken that all food is cooked or boiled, and all water boiled, to prevent intestinal upsets, their chances of surviving the first two years of life are greater than if they have to face the uncertainties of respiratory and contagious diseases of temperate climates.

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## TABES DIABETICA

### Report of Case

By F. E. Angle, Lieutenant (Junior Grade), Medical Corps, United States Navy

Mild nervous symptoms complicating diabetes mellitus are encountered in the large majority of diabetic patients. This led Mettler (1) to the conclusion that "diabetes mellitus is largely a nervous

trouble." Root (2) states that changes in the deep reflexes of the legs are doubtless the most common neurological signs associated with diabetes mellitus, occurring in at least 40 per cent of the cases. Severe nervous symptoms caused by diabetes mellitus are apparently very rare, although most text books (8) of medicine mention the severe forms, among which symptoms closely resembling tabes dorsalis are listed.

Williamson (5), in classifying nervous symptoms in diabetes, suggested the term "pseudo-tabes" for a few cases which he had seen with findings indicating a posterior column degeneration. Krause (3), in reviewing the literature on the subject, suggests discarding all cases prior to the onset of the Wassermann era in 1906. Van Noorden (4), in 1910, said that he had seen only three cases of pseudo-tabes, and one had an alcoholic history.

Williamson (5) and others have shown by pathological specimens that changes in the posterior column may occur in diabetes mellitus, the changes resembling but not identical with those in tabes dorsalis. Head (7) first suggested the term "tabes-diabetica" for this condition, and Major recently reported a very interesting case of tabes-diabetica with complete disappearance of symptoms under dietary and insulin therapy. Major (6) was able to find very few cases in the lierature, and Root (2) states that the apparent rarity of this condition is due to a lack of careful neurological examinations in diabetic patients.

## Case Report

C. R., laborer; age, 34. Veterans' Bureau patient. Admitted to naval hospital, Brooklyn, N. Y., September 21, 1926. Diagnosis: Diabetes mellitus.

*Family history.*—Negative.

*Past history.*—Had the usual childhood diseases. Denies having any venereal diseases, and general health has been extremely good, except for present illness.

*Habits.*—He has used moderately tobacco, tea, and coffee. Denies use of alcohol in any form.

*Injuries.*—None.

*Operations.*—None.

*Chief complaint.*—Frequency of urination, excessive thirst, inability to control urine at night, and unsteadiness in walking.

*Present history.*—Three years ago patient noticed increased thirst, associated with nocturia, polyuria, and increased appetite. About three months after the appearance of these symptoms he developed enuresis, and then he consulted several doctors, who told him he was suffering from diabetes mellitus. He was placed on a diet of C. 30, P. 40, F. 190, and insulin, 15–30 units daily. This treatment kept patient sugar free but he soon developed nervous symptoms, characterized by fleeting pains in both legs and tenderness in the calves of legs. He did not notice any difficulty in walking until about six months prior to entry in this hospital, when patient noticed difficulty in walking at night, especially in climbing stairs. Frequently he has experienced sensations of heat and cold in both lower extremities.

He has had no gastric disturbances that would suggest "crisis." He has been able to control his urine in the daytime but nocturnal enuresis has persisted. He has had no pain nor burning on urination, but some difficulty in starting and stopping stream; has had complete loss of sexual power since onset of present illness.

*Physical examination.*—Patient is a slightly emaciated, middle-aged man, with a distinct disturbance of gait of the "steppage" type.

Height, 5 feet 9½ inches; weight, 120 pounds; T. P. R., normal.

Teeth show advanced peridental infection, which has progressed until all teeth are loose in the sockets.

*Abdomen.*—Marked prominence of the lower abdomen when standing, and, when reclining, a definite tumorlike mass, symmetrical in outline, in the mid line, extending from the symphysis upward for a distance of 17 centimeters and having a transverse diameter of 11 centimeters, is seen. This mass diminished in size after urination.

*Extremities.*—Lower extremities show definite atony of muscles and hypermobility of joints.

### NEUROLOGICAL FINDINGS

Pupils react to light and in accommodation; equal, regular, with marked hippus.

*Reflexes.*—Superficial, present and normal. Deep reflexes, upper extremities, present and normal. Lower extremities, patellar, prepatellar, and Achilles all absent.

*Rhomberg sign*—Positive.

*Babinski.*—Negative.

*Oppenheim and Gordon sign.*—Negative.

Incoordination tests are poorly performed and ataxia is noted in all of his movements. Sensation is not disturbed, except that over lower extremities, from knees down, the temperature sense is sluggish, although he differentiates between heat and cold correctly. The same is true of touch in the same area. Pain sense is normal, although there is a suggestion of hyperalgesia in the soles of the feet.

*Speech.*—No apparent defect in ordinary conversation, but considerable difficulty in repeating test phrases.

### LABORATORY EXAMINATIONS

*Urine.*—Colorless; acid; sp. gr., 1,027; sugar, 2.7 per cent; acetone and diacetic acid, negative; albumin, negative.

*Blood sugar.*—500 milligrams per 100 cubic centimeter blood.

*Blood Wassermann and Kahn.*—Negative.

*Spinal puncture.*—October 14, 1926. Fluid under normal pressure. Wassermann and Kahn, negative. Cell count, 30. Lange colloidal gold reaction, negative. Globulin, faint trace.

*Blood count.*—R. B. C., 4,450,000; Hb., 85 per cent; W. B. C., 8,200.

*Differential count.*—Polys., 60 per cent; lymphs., 34 per cent; L. monos., 3 per cent; eosin., 2 per cent; trans., 1 per cent.

Prostatic examination reveals an enlarged prostate.

*Cystoscopy.*—Residual urine 1,500 cubic centimeters. Bladder capacity not determined. A study of the prostatic orifice showed slight enlargement of the anterior commissure, moderate enlargement of laterals, and a large median lobe completely obliterating the view of the trigone. The bladder mucosa on its

posterior aspect shows marked trabeculation of the obstructive type, with cellule formation and the presence of two diverticulæ on the right side. The anterior surface of the bladder mucosa shows a network of fine trabeculations of the central nervous type, very often associated with tabes dorsalis.

*Course in hospital.*—Patient was placed on diet of C–109, P–66, F–119, and insulin, 30–45 units daily. The blood sugar has varied between 200 and 300 on this diet and the urinary sugar from 1 to 2 per cent, with an average output of 2,000 cubic centimeters. The striking feature in this case has been the pronounced change in the neurological findings on the above diet. The gait has changed from the steppage type to a mild ataxic form, pain has disappeared from legs, no enuresis for past two months, incoordination has been much less, and sluggish deep reflexes have been obtained at times.

Following cystoscopy patient developed an acute cystitis with no subjective symptoms referable to the bladder, although urine was loaded with pus cells.

## Conclusion

It is of interest to note that the severe nervous symptoms in this case followed the taking of a diet high in fats with a glucose-fatty acid ratio of 2.6 for a period of over two years. After being placed on a Joslin diet, as given above, with a glucose-fatty acid ratio of 0.98, his nervous system markedly improved.

The diagnosis of posterior column pathology, believed to be caused by the toxins of severe diabetes mellitus, was made from the following findings:

1. Difficulty in walking, with steppage gait, following the onset of diabetes mellitus.
2. Fleeting pains in the legs.
3. Urinary disturbances, with large distended bladder, and an acute cystitis, following a cystoscopy, with no subjective symptoms of retention or inflammation.
4. Cystoscopic findings of the fine trabeculations associated with posterior column pathology.
5. Deep reflexes of the lower extremities absent.
6. Disturbances in cutaneous sensations of the lower extremities.
7. Atony of muscles and hypermobility of the joints of the lower extremities.
8. Complete loss of sexual power.
9. Variations of the neurological findings since entry in the hospital, which is a constant feature of the few cases of tabes diabetica, which have been described.
10. Negative Wassermann and Kahn reactions on blood and spinal fluid, associated with a negative colloidal gold reaction.
11. Positive Rhomberg sign.

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## TUBERCULOSIS WITH CONCURRENT NEOPLASM[1]

By C. R. Wilcox, Lieutenant (Junior Grade), Medical Corps, United States Navy

### Report of Case

L. M., a white male aged 30, by occupation an ammonia engineer, was admitted to the United States Naval Hospital, N. Y., on March 30, 1927, complaining of vomiting, chills, headache, and weakness.

*Family history.*—Irrelevant.

*Past history.*—While in France during October, 1918, the patient began to feel weak, particularly in the back. He was transferred to a hospital where an X-ray picture of the back was taken and the patient discharged. About six weeks later a swelling appeared in the right lower costal region, posteriorly, which was incised and 5 ounces of pus evacuated. In December, 1919, a similar abscess pointed to the right of the lower thoracic portion of the spine. It was incised and drained. A swelling appeared in the right pectoral region in August, 1921, and enlarged gradually. The patient was admitted to this hospital December 10, 1921, with a diagnosis of lipoma. A history of attacks of weakness in the afternoon with an occasional rise of temperature and night sweats was obtained at that time. Examination showed a painless, movable mass slightly to the right of the sternum and not connected with the nipple. The swelling was incised, disclosing a large abscess. Erosion of the cartilages of the second and third ribs could be seen, with an opening leading into the mediastinum. Postoperative diagnosis was tuberculous abscess of the sternum. The convalescence was uneventful.

*Laboratory findings.*—The sputum was negative for tubercle bacilli. An X-ray examination of the chest (December 22, 1921) showed "infiltration at the left hilum extending upward and at the right hilum extending outward. Suspicious of tuberculosis." The specimen from the abscess gave no growth on culture media and no organisms were seen on the slides.

The patient was readmitted from the Veterans' Bureau May 16, 1924, with the following note from the bureau: "Hospitalization for blood Wassermann, provocative if necessary. Diagnosis and treatment, cold abcess anterior right chest wall. Orchitis, right, progressive, tentative tuberculosis. Thickened pleura, both bases, pleurisy chronic."

The patient stated that he had first noticed the swelling of the right testicle about a year previously and that it had enlarged gradually since that time. There was no pain nor tenderness, and the patient had experienced no discomfort from the condition. Examination showed the patient to be well developed and well nourished. There was slight enlargement of the anterior cervical

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[1] From U. S. Naval Hospital, New York, N. Y.

and inguinal nodes. He had a draining sinus to the right of the sternum in the operative scar. The atrophic left testicle was palpated in the inguinal canal. The right testicle was enlarged, hard, and could not be transilluminated. The swelling of the testicle was thought to be either a gumma or a tumor. The Wassermann and provocative Wassermann tests were negative.

A right orchidectomy was performed (June 4, 1924), disclosing a tumor of the testicle. Pathological report: "Gross specimen is testicle, already opened, measuring 8 by 8 by 5 centimeters. The color is yellowish, with pink-tinged areas. The consistence is soft. The tunica is not adherent. Microscopic: The tumor is composed mainly of very large cells with large nuclei. There is very little stroma, which consists of connective tissue and a few areas of lymphoid cells. Diagnosis: Teratoma testis (embryonal carcinoma), malignant." The convalescence was uneventful and the patient was discharged (June 23, 1924) to the Veterans' Bureau with recommendation that he be given radium treatment for carcinoma. An X-ray examination of the chest was negative (June 20, 1924).

In the interval between his discharge from the hospital in 1924 and his last admission the patient received radium treatment over the right abdomen and X-ray treatment of glands in different parts of the body. The radium treatment totaled 35,000 m. c. hours. The X-ray treatments were given once a week every other three months. These were given at the Memorial Hospital, the last one being on March 22, 1927, about a week before the last admission. The radium and X-ray applications usually upset the patient and were followed by vomiting for a day or two.

*Present illness.*—For the past few weeks the patient has been nauseated, feverish, and has had a headache. The patient has been in bed for the past week and has vomited several times each day. He is unable to retain anything taken by mouth. He complains of a severe splitting headache, of chills running up and down the spine, weakness, and dizziness on attempting to stand. He also complains of dull pains all over the body. The patient has been constipated for the past few weeks.

*Physical examination.*—The patient is weak and markedly emaciated. The skin shows a deep brownish pigmentation over the abdomen and the left supraclavicular region. Two operative scars are present in the right posterior thoracic region and one to the right of the sternum anteriorly. A sinus is present in the scar on the anterior chest wall, but is not draining (although reported to be draining when examined at the Veterans' Bureau before admission here). A few small discrete nodules are present in the right supraclavicular fossa and a larger one in the left infraclavicular space. There is a slight scoliosis of the spine. The pupils react to light and distance. The throat is slightly injected. The tongue is clear. The chest moves well and breathing is of the Cheyne-Stokes variety. Palpation shows slightly increased vocal fremitus over the left chest, anteriorly and posteriorly, and over the scar areas. On auscultation showers of fine and medium moist râles are heard in the left axilla. Bronchial breath sounds are heard over the left posterior portion of the chest between the mid-scapular and lower-scapular regions and in the left infraclavicular fossa to the third interspace. The abdomen is scaphoid in shape, with no rigidity, and no masses are felt. The spleen is palpated on deep inspiration. The liver dullness extends about 2 centimeters below the costal margin, and the liver edge is very tender. The genitalia are abnormal in that the left testicle is undescended and the right has been removed. On examination of the reflexes, the neck is found to be slightly stiff; Kernig, negative; Oppenheim, positive on the right and negative on the left; Gordon, negative; and the knee jerks are normal.

*Progress notes.*—The temperature, pulse, and the rate of respiration were normal on admission. On the second day the temperature rose to 102° F. and the pulse to 110. The respiration remained at normal rate with persistent Cheyne-Stokes arrhythmia. The general condition remained about the same until the night of April 2, the fourth day in the hospital, when the patient began to mutter and appeared to be confused. The note of April 3 states: "The patient is semidelirious this morning. There is considerable confused talking and muttering. Physical examination shows dullness to percussion over the left base, with increased breath sounds, and voice sounds well transmitted. There are fine râles in this region and in the left axilla. The patient has no cough and complains of no pain, but percussion over the posterior base of the chest causes the patient to exclaim. The abdomen is relaxed, and there is tenderness on pressure in the right subcostal region. (T. 102.2, P. 120–140, R. 24.)"

The clinical note of the 4th states that "the patient is semidelirious. Eyes present a staring appearance, with dilated pupils which react but slightly in response to light. The neck is rather stiff. There is some rigidity of the right rectus. The movements of the arms and legs are stiff and guarded. There are positive Babinski, Oppenheim, and Gordon. An attempt at ophthalmoscopic examination was unsuccessful."

April 5, 1927: "The condition this morning appears to be worse. The delirium remains about the same. Respirations appear more shallow and the pulse is of poorer quality. Auscultation reveals many moist râles throughout both sides of the chest. Vocal fremitus is increased over both sides, and percussion note is dull over both bases posteriorly. A systolic murmur is present at the apex, and is fairly well transmitted to the axillary region. The abdomen does not appear to be so rigid as it was yesterday. There are times when the patient appears more rational but does not fully regain consciousness."

The patient died at 8.45 p. m. April 5, 1927.

*Laboratory findings.*—Four blood counts averaged: R. B. C. 4,700,000; W. B. C. 5,500; hb., 80 per cent; polys., 55 per cent; lymph, 45 per cent. The urine was negative until the 4th, when it showed one plus albumin and a fair number of leucocytes. The sputum was negative for tubercle bacilli. Blood Kahn doubtful, Kahn-Wassermann doubtful. The stools showed microscopic and occult blood. Blood chemistry was normal (4–4–27). Urea N, 14.5; uric acid, 2.4; creatinine, 1.6; sugar, 111.

*Spinal puncture.*—(April 4, 1927.) Fluid clear; flow appears to be retarded. Wassermann, negative. Cells, 12. Globulin heavy. No tubercle bacilli. Gold curve: 1112222222.

## Discussion

This case presents an interesting problem in differential diagnosis. The symptoms and findings point toward cerebromeningeal irritation, involvement of the bases of the lungs, and toward some pathological process in the upper abdomen. The definite history of a malignant teratoma testis, and of a series of cold abscesses with a persistent draining sinus in the right pectoral region, leads one to consider a metastatic carcinomatous process, or a generalized tuberculosis as the most probable etiological factor. Other conditions to be considered are encephalitis lethargica, septicemia, pneumonia, and abscess of the mediastinum.

The long history of tuberculous processes about the chest raises some question as to the diagnosis of teratoma testis. However, the pathological report was confirmed by the pathological department of the United States Naval Medical School, and the pathological specimen agrees closely with MacCallum's description of the condition, which follows: "The most common tumor of the testicle is that in which in most parts the cells are uniform in appearance and are large, round cells, arranged in irregular masses or strands, with a stroma which is infiltrated with lymphocytes. It is the rule for these testicular tumors that they grow with extreme malignancy and extend into the spermatic cord and metastasize by way of the veins with great rapidity."

The characteristics of the patient's cerebrospinal fluid preclude the possibility of other meningeal infections, such as the meningococcus, streptococcus, or staphylococcus, because of the great increase in the number of cells which invariably accompanies such conditions. The spinal-fluid findings of this case agree quite well with those found in tumors of the brain, tuberculous meningitis, and encephalitis lethargica.

The spinal fluid of patients with tumors of the brain is normal in appearance, the cells are normal in number, the globulin normal or slightly increased, and the gold curve is variable. The only respect in which the patient's fluid differed from the fluid in brain-tumor cases is in the heavy globulin content it showed.

The spinal fluid in tuberculous meningitis may be clear, opalescent, or turbid, and xanthochromia may be present or absent. The cell count varies from normal to about 250 per millimeter, usually numbering between 100 and 250, with mononuclear cells predominating. There is a slight increase in globulin, and the gold curve is variable.

The spinal fluid in encepalitis lethargica is normal in appearance with a normal or slightly increased cell count, a negative or slight increase in the globulin, and a variable gold curve.

We see from the above descriptions of the cerebrospinal fluids found in cases of brain tumors, tuberculous meningitis, and encephalitis lethargica that a diagnosis can not be made, based upon the patient's fluid alone. The differentiation between tuberculous meningitis and encephalitis lethargica may be most difficult. Krause suggests the following points: "(1) In encephalitis the onset tends to be more abrupt. (2) Vomiting as an early symptom suggests meningitis. (3) When in the stupor of later stages the patient with encephalitis is more easily roused. (4) Marked rigidity of the neck and retraction of the head point to meningitis. (5) More characteristic of the encephalitis are persistent ocular palsies, especially those of conjugate movement.

The onset of the patient's symptoms occurred several weeks before admission, with vomiting as a chief complaint. He had marked rigidity of the neck, so much so that the shoulders could be raised by lifting the head. Ocular palsies were not observed, the patient's eyes being fixed in an upward stare. These findings all point toward tuberculous meningitis rather than encephalitis. The symptoms of metastases to the brain may be so variable, depending upon the structures involved as to render futile an attempt at diagnosis based upon the findings in this case.

The symptoms and findings of lung tumors as briefly outlined by Austrian are as follows: Fever, dyspnea; pain referred to arm and shoulders; cough, often unproductive; sputum purulent and occasionally resembling currant jelly, some time containing pieces of lung tissue or cancer cells; hemoptysis often. Tuberculosis and cancer coexist in 15 to 35 per cent of the cases. Suggestive physical findings are (1) diminished expansion on the involved side; (2) localized areas of dullness with impaired breath sounds but occasional tense, shrill, tubular breathing which resembles cavity; (3) if the pleura is involved there is pleurisy with effusion; (4) metastatic tumors may show only persistent râles or pleural effusion. The prognosis is exitus from cerebral metastases or cardiac failure.

The patient had no cough, no sputum, and no dyspnea. Breathing was characteristically Cheyne-Stokes. The chest findings which might indicate a metastatic process in the lungs were fine râles and impaired percussion note over the left base, posteriorly, accompanied by bronchial breathing.

These findings might also indicate a diffuse, patchy pneumonic process in the left lower lobe. The absence of cough and rapid breathing with the expiratory grunt characteristic of lobar pneumonia practically precludes a true consolidation. It is interesting to speculate upon the character of breathing which would result from a concurrent meningitis and pneumonia.

The moderate leucopenia with relative lymphocytosis agrees well with the blood findings occurring in carcinoma and generalized tuberculosis and make a septicemia of pyogenic origin or a true pneumonia quite improbable. However, the patient had just completed a series of X-ray and radium treatments, which may have produced an artificial leucopenia and prevented the normal reaction of the hematopoietic system to pyogenic infections.

The palpable spleen gives no definite diagnostic clue, as one might expect to find some splenic enlargement in malignancy and generalized tuberculosis. The presence of a recently closed sinus from an old operation which disclosed an abscess in the mediastinum indicates the possibility of a recurrence of this process. If such a condi-

tion existed, one would expect to find an increase in the width of the retromanubrial dullness, but none was noted on examination of the chest.

One of the chief complaints was pain in the right upper quadrant of the abdomen. The abdominal wall was not markedly rigid, but the patient winced on palpation over this area and held his arm as a protection to it. No masses could be felt, but the liver was a little enlarged and seemed to be tender. Involvement of the gall bladder was thought unlikely, due to the absence of jaundice, low leucocyte count, normal urine, and normal stools. A diaphragmatic pleurisy has been known to produce pain, which the patient describes as being in the right upper abdomen.

In summary we have a patient showing symptoms of meningeal, pulmonary, and upper abdominal involvement, with laboratory findings which may be found in encephalitis lethargica, generalized tuberculosis, or in a metastatic carcinomatous process. Encephalitis is discarded on account of the symptoms previously described and because of the history of earlier tuberculosis and carcinoma. This leaves tuberculosis and carcinomatosis as the most probable etiological factors.

Although DaCosta states that secondary growths from carcinoma of the testicle occur early and are widespread and common in the skin, the moderate generalized glandular enlargement may well have been due to tuberculosis. The sinus in the chest had been draining until a short time before admission, showing that the tuberculous infection was probably still active.

While it is always possible that a series of symptoms and signs may be caused by two or more concurrent etiological factors, it is a good diagnostic principle to lay the blame for the whole process upon a single agent, providing that all of the phenomena can be explained upon that basis. It is believed that a generalized tuberculosis accounts for the entire clinical picture presented by the patient during his last hospitalization here.

## Pathological Report

*Brain.*—The pia was universally injected, and under it, in several places, but particularly at the base of the brain, was pus from which smears showed numerous tubercle bacilli. In the right cerebral hemisphere, just above the fissure of Rolando, was a cortical abscess the size of a green pea, from which smears showed tubercle bacilli. Microscopic: Left choroid plexus vessels considerably engorged. There are no tubercles. Medulla: Scattered throughout the medulla there are many large phagocytic cells. There are no vascular changes of note. The pia is very cellular from invasion of mononuclear cells. Here and there can be seen a few discrete miliary tubercles. Section of the abscess of the right cerebral hemisphere shows many polynuclears and round cells. It appears like a secondary infection, for there are areas of caseation

and conglomerated tubercles. Pituitary shows many miliary tubercles, areas of caseation, and giant cells.

*Lungs.*—Both lungs showed advanced passive congestion. Definite pneumonic areas could not be palpated, but throughout both lungs were numerous areas very suggestive of young miliary tubercles. There was no pleurisy active, but the right apex was bound down by rather dense adhesions. Microscopic: Right lung, apex, there are several miliary tubercles scattered throughout the section. Some are quite large and appear to be conglomerated, with areas of caseation and giant cells. Middle lobe, same as right apex. Base, there are many miliary tubercles. Considerable passive congestion is observed. There are many definite pneumonic areas in which the alveoli are filled with polynuclears and round cells. Left lung was like the right.

*Heart.*—There was a most extensive pericarditis of the adhesive type. At no place could the parietal and visceral layers be separated. The incident fibrosis resulted in ½-inch thickness of the pericardium. In the heart muscle were many areas of fibrosis. There was a definite chronic myocarditis, although neither dilatation nor hypertrophy was pronounced. The valves were normal. Slight arteriosclerosis was noted in the aorta. Microscopic: Section of the left ventricle showed considerable cloudy swelling and degenerative changes approaching the hyaline stage. There is considerable hyaline degeneration of the right auricle. The musculature is definitely atrophied. The aorta shows a moderate amount of degeneration of the intima.

*Liver.*—The liver was definitely lobulated and cirrhotic, but the size was practically normal. No tubercles were seen grossly. Microscopic: Moderate passive congestion. There is a definite increase in the intrahepatic tissue of Glisson's capsule. Throughout the section there are many miliary tubercles.

*Spleen.*—The spleen weighed 400 grams. There were areas suggestive of tubercles. Microscopic: Shows many miliary and conglomerated tubercles.

*Kidneys.*—Both kidneys showed a fairly far advanced chronic nephritis and both were rather acutely congested. In neither one, however, were tubercles seen. The capsule stripped with ease, but there was a considerable increase in the pelvic fat. The right ureter was dilated sufficiently to admit the little finger, but there was no apparent obstruction. Microscopic: Right and left, there is some increase in fibrous tissue replacing tubules, with associated changes in the glomeruli leading to fibrosis. Most of the glomeruli are acutely hemorrhagic. Some of them are partially filled with exudate. The renal epithelium is swollen and shows granular degeneration. There is considerable albuminous material in the tubules, but casts are not definitely visualized. The vessels everywhere are acutely engorged. There are no striking arteriosclerotic changes. In some of the tubules there are many red blood cells.

*Adrenals.*—Both adrenals were largely involved by caseation, and the right adrenal was partially broken down into pus from which smears showed tubercle bacilli. Microscopic: Shows massive areas of caseation, tubercles, and giant cells.

*Pancreas.*—Negative macroscopically and microscopically.

*Gastro-intestinal tract.*—Showed no ulcerative lesions of the mucosa nor were there any tubercles in the serosa. The parietal peritoneum, however, was everywhere studded with tubercles, some discrete and miliary, others conglomerated. Microscopic: Shows many areas of caseation, tubercles, and giant cells.

There was a cold abscess along the lumbar and lower dorsal vertebrae and smears from this pus showed tubercle bacilli. The body of the first lumbar vertebra was broken down and connected with the abscess.

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*Lymph gland, left side of neck.*—There is no suggestion of tuberculosis, but the entire structure is invaded by an embryonal type of cell, among which many mitotic figures are visualized.

*Pathological diagnosis.*—Metastatic carcinoma or embryonal tumor; general miliary tuberculosis.

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# SOME RECENT WORK IN LEUKEMIA[1]

## WITH REPORT OF THREE CASES

By J. B. GORDON, Lieutenant (Junior Grade), Medical Corps, United States Navy

A voluminous literature has accumulated dealing with that group of diseases characterized by progressive enlargement of the lymphoid tissues. As is usual, when there is a great deal being written about a problem not thoroughly understood, the terminology has grown confused and ambiguous, so that articles and discussions are seen in which similar or identical conditions are called by different names. It is now proposed to group all of these diseases characterized by a malignant production and enlargement of the lymphoid tissues of the body under the term *lymphoblastoma*, this term being intended to include the diseases now known by the names: Lymphatic leukemia (both lymphocytic and lymphoblastic types), aleukemic lymphatic leukemia (pseudoleukemia and lymphadenosis), lymphocytoma, Hodgkin's disease (lymphogranuloma), lymphadenoma, lymphomatosis, lymphosarcoma, round cell sarcoma, leukosarcoma, lymphadenosarcoma; and, less precisely, to include Banti's disease, chloroma, and Mikulicz's disease.

As regards age and sex incidence, Minot has shown in an analysis of 477 cases of all types of lymphoblastoma (including lymphatic leukemia) that there are two peak points as to age susceptibility and that males are definitely more prone to have the disease than females. The first peak shows the highest incidence of onset for males and for both sexes to be between the ages of 20 and 24. Of Minot's 477 cases, 327 were males and 150 females, a ratio of 2.12 to 1. The second peak shows a difference in sex distribution, the height being greatest in

[1] From U. S. Naval Hospital, New York, N. Y.

males between the ages of 35 to 39, and in females from 40 to 44. The highest incidence in women is thus seen to develop later in life than in men. Considering Hodgkin's disease alone, the greatest incidence was found in the decade of 20 to 30 years of age.

Treatment of these conditions may be summarized under five headings: 1. Irradiation. 2. Arsenic. 3. Benzol. 4. Surgery. 5. Transfusion. Irradiation is given by both the Röntgen ray and with radium, generally using the two in conjunction and subjecting the lymphoid tissues, especially the spleen, the mediastinal and cervical aggregations, and the long bones to multiple exposures at varying intervals, depending on the regression of the white count and the size of the structures being treated.

The arsenic preparations used are numerous, the most popular being sodium cacodylate, liquor potassium arsenite, and arsphenamine or its newer modifications. Benzol therapy is waning in popularity. The white count can unquestionably be brought down by the administration of this drug, but the reduction is difficult to control and continues after the administration of the drug has been stopped. A destruction of red cells is a concomitant feature, and a severe grade of anemia is often produced in patients who can ill afford to lose their resistance and fighting power.

Under surgery, such procedures as splenectomy and excision of hypertrophied masses of lymphoid tissue are grouped. While often affording temporary relief by the removal of pressure symptoms and improvement of cardiac and respiratory action, these measures are in no sense curative. Transfusion is used as a symptomatic remedy for the severe grade of anemia which always occurs, with resulting lowered resistance and cardiac embarrassment, and, of course, has no action in attacking the disease itself.

At this time the main reliance is placed in irradiation, though its ultimate value is disputed. A. U. Desjardins, from an analysis of 49 cases of Hodgkin's disease and 97 cases of lymphosarcoma treated by radio therapy, concludes that "it does not appear that radium and radio therapy notably prolong life, though symptoms can be improved by reducing general glandular enlargement." In considering the results of radiation therapy in his 477 cases, Minot concludes that radiation is of doubtful value even in prolonging the course of the disease. Four hundred and one of this series are now dead; 238 of these were treated with Röntgen ray or radium and 163 were not. Comparison of the length of life of irradiated and nonirradiated cases does not indicate that this treatment affects the duration of lymphoblastoma. The average duration of the disease in all cases in this series was 2.76 years. He believes that surgery can probably influence the course of the disease beneficially, especially if employed early and followed by irradiation.

In the December 5, 1925, issue of the Paris Medical Journal there appeared an article, "Treatment of myeloid leukemia," by E. Sergent and R. Mignot, in which the conclusion was drawn that X ray over the spleen and long bones may be employed with temporary relief, prolonging life from 4 to 7 years, the patients responding well at first but later poorly. They advocate the use of radiation in conjunction with benzol and thorium.

T. Lucherni reported in Policlinico, Rome, December 14, 1925, a case of leukemia treated by the inoculation of malaria. The patient, a boy of 14, had large, hard spleen and liver, with 250,000 white blood cells, 73 per cent of which were myeloblasts; 1,500,000 red blood cells; and 24 per cent hemoglobin. Three cubic centimeters of blood infected with the *Plasmodium vivax* was injected subcutaneously. A typical malarial attack followed 12 days after the injection. After 12 malarial paroxysms the disease was arrested by the administration of 1.5 grams of quinine daily. One month later the white blood cells had fallen to 5,800, nearly all of mature types; the red bloods cells had risen to 3,800,000 and the hemoglobin to 52 per cent. The spleen had been reduced to nearly normal size.

Bini, in the January 18, 1926, issue of the same journal, reports two cases in which beneficial effects followed accidental malarial infection in cases of leukemia.

It has been observed that leukemia cases developing lobar pneumonia, one of the acute exanthemata, or some disease resulting in hyperpyrexia for a considerable period, if they succeed in weathering the intercurrent infection, have their leukemic symptoms and findings much improved afterwards.

Ferrata has recently described a mother cell, which he terms a "hemohistioblast," with azure staining granules, and which he believes to be the progenitor of both the myeloblasts and the lymphoblasts; the myeloblastic cell being an early, and the lymphoblastic cell a later, more completely evolved, and matured development of this originally identical forbear. This is of interest in connection with case 1 (following), the pathological diagnosis of which was a mixed leukemia starting as myeloblastic and terminating as lymphoblastic.

One of the cases reported here had an eosinophilia of eight. Apropos of this it is interesting to note the case of Schmidt-Weyland, reported in November, 1925, having an eosinophilic leucocytosis; 67 per cent of the 90,000 white blood cells being eosinophils. The blood picture here was accompanied by ulcers of the sigmoid and eosinophilic infiltrates in the mesenteric nodes and spleen.

As regards the origin of the heteroplastic aggregations and infiltrations of lymphomata and myelomata in the liver, kidneys, heart, and spleen which are found at autopsy in these cases, Ewing gives two theories: First, that they arise from so-called "slumbering"

lymphoid or myeloid foci, which are probably present in normal organs and which are stimulated to an enormous hyperplasia by the unknown cause of this disease; and, second, that they represent metastatic growths of embolic nature wh.ch arise from cells swept to these points by the blood stream, there setting up new localized growths.

The following three reports are of cases of leukemia which recently came to termination in the United States naval hospital, New York, N. Y.

*Case 1* (J. E. H. No. F22854).—White male; age, 30; occupation, mechanic; entered hospital August 23, 1926.

*Diagnosis.*—Tonsillitis, acute.

*Chief complaint.*—Sore throat and gums. The tonsils were hugely hypertrophied and the left one bore a dirty yellow ulcer. Smears from the tonsils on admission showed the organisms of Vincent's angina. A blood count done the next day showed 52,500 white blood cells, with 89 per cent lymphocytes. A repeat on the day following showed 49,900 white blood cells, with 89 per cent lymphocytes, and diagnosis was changed at this time to leukemia, acute lymphatic.

The history of this patient was, in brief, as follows: Two weeks before admission he developed a slight sore throat which grew steadily worse and did not respond to local treatment. His gums became swollen and tender and bled a little. He had had a gunshot wound of the left parotid region with a resulting left mastoiditis. Mastoidectomy had been performed. The only disease he had had was typhoid fever at age of 13. His family history was entirely negative and his habits exemplary; there was no history of exposure to hemolytic agents.

Physical examination showed an acutely sick man, temperature 99, breathing with some difficulty and talking with evident throat obstruction. The skin, mucous membranes, and nails were very pale. There was a left sided facial paralysis resulting from the gunshot wound, and this side of the face twitched frequently. The left pupil was widely dilated and did not react to light, and the left eyelid could not be completely closed voluntarily. There was a horizontal scar over the left parotid. The left ear was completely deaf, with a sclerosed external auditory canal from which oozed a slight amount of purulent exudate. All the teeth were loose, the gums were swollen, boggy, and tender to touch. Tonsils greatly enlarged, ragged and cryptic, with a dull yellowish membrane over the left one. Submaxilliary, cervical, supraclavicular, inguinal and epitrochlear lymphatics were enlarged bilaterally. Lungs at this time were entirely clear. Heart showed a faint short systolic mitral murmur poorly transmitted; pulse 100, blood pressure 110–60. The liver extended 1.5 inches below the costal margin and the spleen at this time descended 2 inches below costal margin on deep inspiration. Abdomen otherwise negative. Genitalia normal; no sign of a luetic primary lesion; venereal history denied. Reflexes were normal except for a slight amount of ankle clonus. Examination of ocular fundi showed them to be of very pale hue with pale vessels and a general haziness; edges of the discs were indistinct and the physiological cups were large. There was no leukemic spots and no characteristic changes of leukemia, though the general appearance was suggestive of this disease.

*Laboratory work.*—White blood cells on admission were 52,500. They continued to rise steadily, reaching 180,000 a few days before death. Hemoglobin gradually fell from 65 per cent to 30 per cent. There were 89 per cent lymphocytes on the first two counts, but a note was made by the laboratory that 20 per cent of the reported lymphocytes gave a peroxidase reaction and were myeloblasts, and the opinion was expressed that this was a mixed leukemia, having started as a myelogenous and terminating as a lymphatic type. A red count two days after admission showed 2,680,000; blood platelets 112,560. Urine was at first negative, later showed a trace of albumin and many coarsely granular casts. Blood chemistry: N. P. N. 32, urea N. 9.2, uric acid 4.2, creatinin 1.9, sugar 107. Coag. time 2 minutes 40 seconds, bleeding time 55 seconds. Two blood cultures, the second taken the day before death, were negative. Blood Wassermann negative. Smears of ear discharge showed many pus cells, Gram negative bacilli and cocci and Gram positive cocci; culture showed *Staph. albus.*

The course of this patient was rapidly downward. The spleen continued to increase rapidly in size. With cardiac exhaustion loud murmurs were heard all over the precordium and moisture was evident in the lungs. He passed through a period of several days' vomiting after several antemetic measures had been tried unsuccessfully. On September 17 he became delirious and seemed to be in a very weak and exhausted state. Death occurred at 4.11 a. m. on September 19.

*Autopsy* showed enlarged mediastinal glands, leukemic spots distributed through the liver, kidneys, and right ventricle of the heart. Spleen weighed 700 gms. and showed leukemic infiltration of three-fourths of its substance. On section a large proportion of the infiltrating cells were myeloblasts, as determined by azur B stain and peroxidase reaction.

In the way of therapy this patient was given intramuscular injections every other day of sodium cacodylate, and one intravenous injection of 0.3 gm. neoarsphenamine. Local applications of Fowler's solution and antiseptic gargles were used to the Vincent's ulcer. Digitalis was used when the circulation began to fail. Consultation was held to determine the advisability of irradiation and transfusion, but these measures were decided against.

*Case 2* (W. F. H. No. 22899).—White male, age, 54; native of this country; entered hospital, ambulatory, August 26, 1926, with a diagnosis of splenitis. His chief complaints were weakness, loss of weight and strength, and a painless abdominal tumor.

*Family history.*—Mother and father dead; cause unknown. Three brothers and two sisters died of heart disease. One child of patient's had died with heart disease. Family history otherwise negative.

*Past history.*—He had had malaria and typhoid fever in 1899, and lead poisoning in 1916; no other diseases, operations, or injuries.

*Present illness.*—In February, 1926, he had noticed a painless lump in upper left quadrant of abdomen and had consulted a physician at this time. He was given arsenical tonics, which caused no regression in the size of the tumor, did not stop his loss of weight and strength, and which seemed to cause a profuse crop of large pimples and furuncles all over his body. Since present illness patient had noticed blurring of vision in the evening; 10 years ago sudden unexplained deafness in left ear had occurred. Heart symptoms absent except for some edema of ankles in the evening. No cough or hemoptysis. Bowels had always been regular until recently when, with the increasing size of the tumor, he had become very constipated, and was taking cathartics

frequently. Had never had any urinary symptoms except some polyuria and dysuria years ago when working in turpentine a great deal. Nervous and marital histories irrelevant.

*Physical examination.*—Showed a well-developed man, 54 years old, able to walk about and in no acute pain or distress, though obviously weak and below his usual vigor. The whole body was covered with large pimples, a few of which had suppurated and become furuncles. Vision in each eye was 2–20; examination of eye grounds showed fundi to be lighter in hue than normal, with slight engorgement of the veins, which showed white lines in the middle. No hemorrhages, evidences of retinitis, or leukemic spots were present. Many teeth were missing. The heart was slightly enlarged to the left, and there was a poorly transmitted systolic murmur heard over the apex; rate and rhythm were normal. Lungs clear throughout. Abdomen markedly distended by a mass about the size of a football in left side, extending downward to the brim of the pelvis and medially to the midline. There was a small reducible right femoral hernia of short duration. Inguinal glands were enlarged and hard, veins over left leg were enlarged and prominent, though not definitely varicosed. Reflexes normal. Blood count on admission showed 3,240,000 red blood cells, with hemoglobin, 70 per cent, white blood cells, 187,000; polys., 60; lymphs, 3; eos., 8; bas., 4; myelocytes, 18; normoblasts, 7. White cells continued to rise, reaching a maximum of 325,000 on September 2, then gradually declining to 277,000 a few days before death. The percentage of myelocytes ranged from 18 to 40. Normoblasts were present in each count in from 7 to 22 per cent. Blood Wassermann negative. Urinalysis showed 1+ albumin, with many coarse and fine granular casts. Gastric analysis after a test meal showed a trace of blood, with normal HCl and total acidity. The splenic tumor shortly after admission began to increase rapidly in size, the increase being perceptible each day. With this enlargement there were progressive weakness and embarrassment of cardiac and respiratory functions. On September 10 he was given 4–5 erythema dose of X ray over area of spleen. Two days later patient started vomiting, first greenish material, later solid and liquid fecal matter. All food was stopped by mouth and proctoclysis and hypodermoclysis (2,000 c. c. per day) were started. After two days of fecal vomiting, blood chemistry showed an N. P. N. of 38, urea N. 26.1, uric acid 3, creatinin 1.3, and sugar 131. Surgical consultation for the advisability of interference for the intestinal obstruction and reverse peristalsis was obtained and operation decided against. After the third day of vomiting, patient began to have involuntary bowel movements and the vomiting ceased. He was immediately started on small doses of whiskey and small quantities of hard, dry carbohydrate food. This was well retained. Patient lapsed into a semiconscious state two days before death. Death occurred on September 18. No autopsy was obtained.

*Case 3* (G. C. No. 23417).—Patient a white male, aged 33, of Greek nationality, born in Constantinople. Entered hospital October 15, 1926.

*Diagnosis.*—Influenza.

*Chief complaints.*—Cough, fever, malaise, weakness, and abdominal tumor.

*Past history.*—His occupation had been a cook for past 18 years. There was no history of exposure to hemolytic agents. Outside of hernia, which everyone in his family had, there is nothing worthy of note in the family history. Patient had had four infections of gonorrhea 10 years ago and several attacks of malaria at age of 16. Twelve years ago he was circumcised, and at this time he bled a great deal; since then he has had frequent bleeding from the nose and gums.

*Present illness.*—About 7½ years ago, while he was in Europe in the Army, he became very weak and started up a persistent vomiting. He noticed a lump in his abdomen then. Medical consultation was had at this time without diagnosis of the condition. His vomiting continued at intervals for two months, accompanied by fever. During this time he lost 20 pounds' weight. Six months after onset of symptoms he was diagnosed leukemia. Blood count at this time was, red blood cells, 1,500,000; white blood cells, 325,000. At this time X-ray therapy over the spleen was begun. Between 40 and 60 treatments were given and the spleen shrunk to 3 fingers' breadth below costal margin. Benzol and other drugs were used without affecting a further reduction of the spleen or improving symptoms. After this series of irradiations, white blood cells were down to 20,000 and appetite and strength improved for about one year. Symptoms gradually returned. He was given 15 more X-ray treatments and spleen was again reduced in size. During the next few months he received physiotherapy until symptoms again overcame him and he was taken to Memorial Hospital, New York. He received at this hospital 5 radium treatments at intervals of six months, the last radium application being two weeks before his admission to the naval hospital and one week before the development of his acute chest symptoms.

*Physical examination* showed a well-developed male with an abundance of well-preserved subcutaneous fat. The skin was of a yellowish anemic hue and was very hairy except over the area of the spleen, where epilation had occurred. Eyes normal to external examinations. Pharynx, injected; tonsils, small; bucchal mucosa, very pale; mouth, foul, with sordes over gingival margins, no bleeding spots; nasal mucosa acutely congested and inflamed. Chest emaciated, with sunken supra and infraclavicular fossae; respiration, 32; bronchial breathing over whole left chest anteriorly, posteriorly, and in axilla; occasional crepitant râle along left scapula border, moist râles in both bases, posteriorly. Heart slightly enlarged to left, its left border blending with splenic dullness, there was a blowing systolic murmur over the mitral area, faintly heard over the aortic area, not transmitted to axilla or back. Blood pressure, 124–60; rate, 134. Abdomen distended by large splenic tumor which extends from midway down left axilla well into pelvis and across midline nearly to rt. ant. sup. iliac spine. There was some vague abdominal tenderness, most marked in right lower quadrant. Spleen hard and not tender to pressure or manipulation. There was a large left and a small right indirect inguinal hernia, both incomplete. Left knee jerk, sluggish; Babinskis, normal; no edema, varicosities, ecchymoses, or evidence of hemorrhage. There was no general glandular enlargement so far as superficial lymphatics were concerned; cervical, submaxillary, supraclavicular, and inguinal glands of normal palpability; no epitrochlears felt.

This patient lived only 6½ days after entering hospital. Blood count on admission was red blood cells, 3,240,000; hemoglobin, 69 per cent; white blood cells, 74,450; polys., 70; lymphs., 5; bas., 1; neut. myelocytes, 20; myeloblasts, 2. On the day before death the blood count was: White blood cells, 226,000; polys., 82 per cent; lymph., 1; trans., 1; neut. myelocytes, 12; myeloblasts, 2. Urinalysis showed a trace of albumin. Smears and cultures from the pharynx were negative for organisms of Vincent's angina and diphtheria.

Patient rapidly became weaker and very dyspneic, though he failed to develop any definite consolidation or infiltration process in the lungs. On October 20, five days after admission, he began to ooze blood from the left nostril. This was partially controlled by packing with adrenalin chloride, but

slight bleeding continued, draining into pharynx. Death occurred at 8.15 a. m. October 22, 1926. The highest temperature was 103; pulse stayed between 110 and 120; respiration continued to rise, reaching 48 on the day before death.

Therapy in this case was limited to the administration of digitalis as a support to the circulation and symptomatic treatment for the cough, sleeplessness, and epistaxis.

Autopsy revealed a huge splenic tumor, weighing 6,000 grams, filling the abdomen and raising the left dome of the diaphragm. The liver was enlarged 10 centimeters below right costal margin and showed multiple myelomata studded through it; small myelomata were present in both kidneys.

## TREATMENT OF GONORRHEAL OPHTHALMIA[1]

By E. C. Ebert, Lieutenant Commander, Medical Corps, United States Navy

With a view of determining the value of milk in the treatment of gonorrheal ophthalmia, a comparative study with some of the common remedies was made during the past two years. During this time 92 cases came under our observation. Of these, 41 received the combined treatment of subcutaneous and intramuscular injections of milk, in addition to local treatment with argyrol and mercurochrome. Twenty-six received local treatment alone every two hours with boric acid irrigation, followed by instillation of argyrol. Twenty-five cases were used as a control, receiving various treatments as follows. (See chart.)

First, five were treated with 5 per cent argyrol. The second group of five received milk injections only. Third group of five received 2 per cent silver nitrate locally. The fourth group were treated with 1 per cent mercurochrome, and the fifth group was also treated with 5 per cent argyrol. The reason for repeating the argyrol series was to confirm the satisfactory results obtained in the first group. To avoid lengthy discussion, we are omitting the history, symptomatology, diagnosis, and complications, and will confine ourselves to observations of various treatments.

Before the patient was admitted for treatment, laboratory diagnosis (Gram's stain) was made to confirm the clinical diagnosis.

Comparing the 41 cases receiving the combined treatment with the 26 cases receiving local treatment, no difference in time of response to treatment was noted. In both of these groups, cures were obtained in from 7 to 10 days if the eyes were properly cleaned and free of pus. Improperly cleaned cases frequently developed corneal ulceration.

The miraculous improvements that are frequently attributed to milk therapy, such as disappearance of chemosis and pus within 24 to 48 hours, were often observed in cases treated with argyrol alone,

[1] Read before the Société de Médicine d'Haiti, February, 1927.

as may be noted in Figures 1 and 2. Figure 1 shows case on admission; Figure 2, 36 hours after treatment (local) was instituted.

Comparing the controls, the first group of five was treated with 5 per cent argyrol every two hours, after a preliminary boric-acid irrigation was made. One per cent atropine was instilled before treatment was begun. Lids and lashes were properly cleaned and all crusts removed. It is our opinion that corneal ulcers frequently follow minute abrasions due to dried secretions. This group responded to treatment in eight days.

The second group was treated with milk injections varying in amounts from 0.5 cubic centimeter in the new born to 6 cubic centimeters in adults every second day. This group received no local treatment. Some of the milk used for injection was sterilized and some was unsterilized. The results obtained, as is noticed in the chart, were very discouraging. Every case developed corneal ulcers, two with perforations. Because of unfavorable results obtained in the other four cases, and no improvement noted after first injections in the fifth case of this group, milk injections were discontinued. In every case of this group local treatment was eventually instituted because milk did not give any satisfactory results. Cures were eventually obtained in periods averaging 13 days.

The third group was treated with 2 per cent silver nitrate locally. The results were fairly good and only one case developed a corneal ulcer. Silver nitrate apparently is too irritating in acute cases. A marked conjunctival congestion seems to persist with silver nitrate. It should be used in more chronic cases on alternating days in conjunction with mild antiseptics.

The fourth group was treated with 1 per cent mercurochrome. No ulceration resulted. (See chart.)

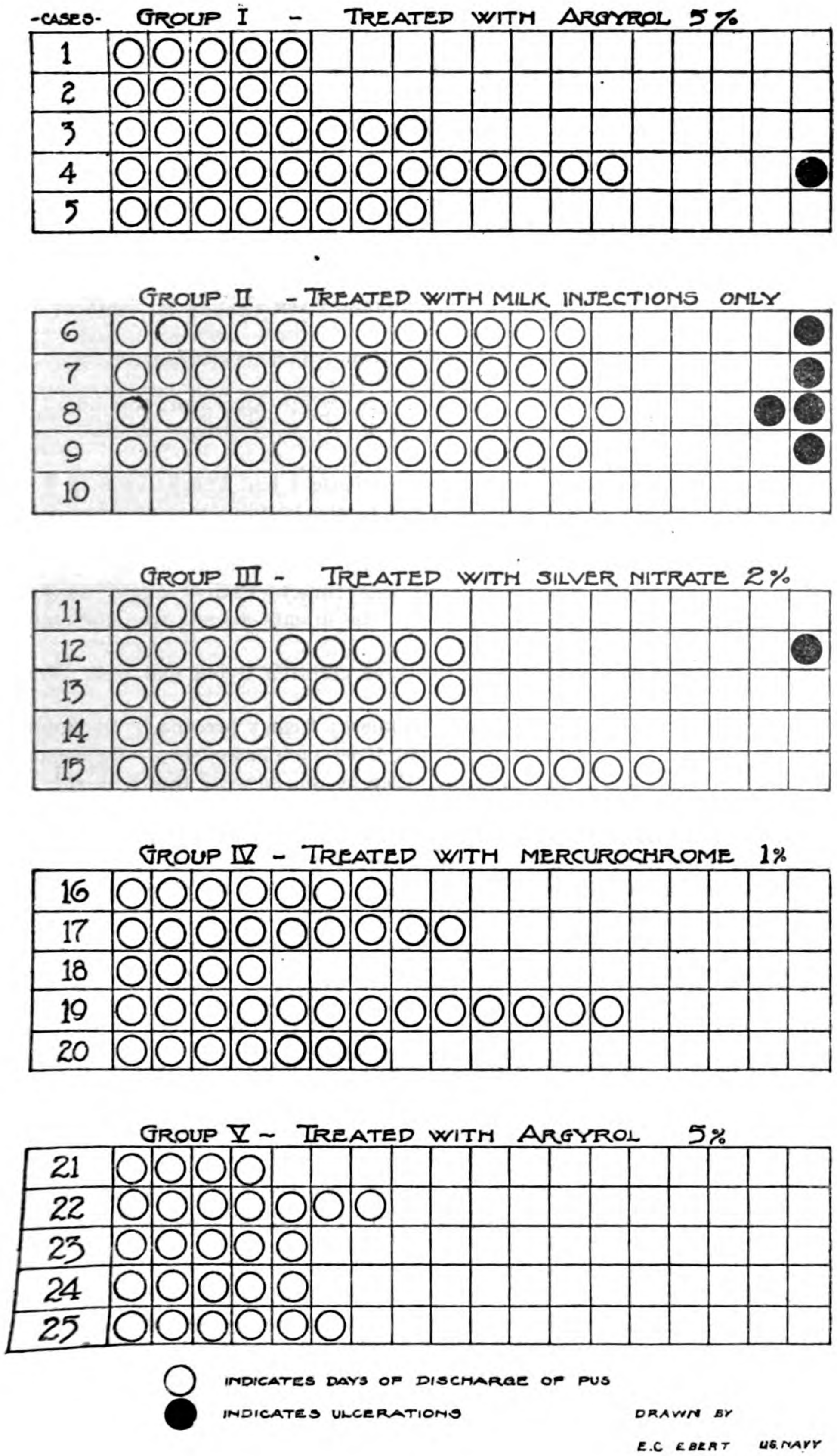
The fifth group was treated with 5 per cent argyrol. No ulcerations developed and the cases were cured in an average of 5.5 days.

Antityphoid vaccine therapy for gonorrheal ophthalmia was not used. Reports obtained from one of our leading clinics in the States show that argyrol must be used in addition to antityphoid vaccine. Then the cures are obtained in from 7 to 14 days.

During the treatment of these cases two were of special interest. One, a male adult, disappeared immediately after diagnosis was made and did not return until a week later. When he returned he was well and developed no ulcers. The other, a young woman, received only three treatments with 1 per cent mercurochrome and did not return until the eighth day. In the meantime she developed a small ulcer, but this healed in two days.

FIG. 1.—PATIENT, AGED 4. PUS PROFUSE AND CHEMOSIS MARKED, CONDITION FREQUENTLY OBSERVED ON ADMISSION

FIG. 2.—SAME PATIENT, 36 HOURS AFTER ARGYROL AND BORIC ACID TREATMENT WAS STARTED


-CASES- GROUP I - TREATED WITH ARGYROL 5%
GROUP II - TREATED WITH MILK INJECTIONS ONLY
GROUP III - TREATED WITH SILVER NITRATE 2%
GROUP IV - TREATED WITH MERCUROCHROME 1%
GROUP V - TREATED WITH ARGYROL 5%
INDICATES DAYS OF DISCHARGE OF PUS
INDICATES ULCERATIONS
DRAWN BY
E.C EBERT US NAVY

### Conclusions

1. Milk injection apparently has no therapeutic value in the treatments of gonorrheal ophthalmia.
2. Combined with local treatment, milk injection has no advantage over local treatment alone.

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## PERNICIOUS ANEMIA[1]

### Report of an Unusual Case

By R. Krohn, Lieutenant (Junior Grade), Medical Corps, United States Navy

M. B. W., C. T. M., Ret.; male, age, 39 years; white American; was admitted to United States Naval Hospital, New York, N. Y., February 7, 1927, as a stretcher case.

*Past history.*—According to his own word patient had always been in good health, but a civilian doctor who sent him to the hospital was communicated with. Patient first came under his observation in January, 1925. Diagnosis of cardiorenal disease with hypertension (170/110) was made, and patient subsequently improved. (No anemia at this time.) Patient again went to this doctor in January, 1927, at which time the intense anemia was discovered and he was sent to hospital.

*Family history.*—Married nine years, three children living and well. Wife has had two miscarriages.

*Present history.*—Chief complaints, weakness; "can't breathe." In December, 1926, patient began to feel weak and tired and lacked pep. He became progressively worse until two weeks ago, when he was so weak that he had to go to bed. He has been very short of breath, especially during the past two weeks. His feet swell when he is up and about. Patient has vomited very occasionally during past six months—vomiting when it occurred was in the morning. There has been some diarrhea for past two and one-half months, but this has not been continuous and bowels and stools have been normal between periods of diarrhea. Appetite has been failing for past year and a half and is very poor of late. Tongue and mouth have been "sore for some time." Has had painful hemorrhoids past two months. Nycturia two or three times past one and a half months. Patient also complains of numbness and tingling of hands and feet for past four months. Slight blurring of vision recently.

*Physical examination.*—Reveals a man of about the stated age apparently acutely ill and in a somewhat stuporous condition, well nourished, with no apparent loss of weight. Very pale and anemic looking, pallor being of an icteroid tint.

Mouth: Tongue smooth, papillae atrophied, deep red color, and very hypersensitive to touch. Mild stomatitis present, with slight bleeding from the gums. Two anterior molars decayed. Breath very foul.

Eyes: Conjunctivae show icteroid tint.

Chest: Mild congestion at bases of lungs.

Soft-blowing systolic murmur at apex of heart; not transmitted.

Abdomen: Protuberant; suggestion of fluid wave, but thought to be due to excessive fat.

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[1] From U. S. Naval Hospital, New York, N. Y.

Liver: Enlarged four fingers below costal margin.

Spleen: Not palpable.

Rectum: Small external hemorrhoids.

*Neurological findings.*—Lower extremities: Some disturbance of sensation in both legs and feet. Difficulty in distinguishing between sharp and dull points. Above the right knee there is an area about 15 centimeters in diameter in which there is complete anesthesia. Total loss of position sense of the toes of both feet is present.

Upper extremities: No apparent abnormalties except a marked weakness of extensors of both hands (patient has a hard time feeding himself).

Reflexes: Tendon reflexes slightly decreased. No ankle clonus. No Babinski. No Gordon. Rhomberg not tested.

*Course in hospital.*—Patient on admission was apparently in extremis and he ran a rapidly fatal course in the hospital. The course was progressively downward and was neither interrupted nor apparently hastened by a blood transfusion of 500 cubic centimeters. He ran a daily remittent type of temperature while in the hospital, high points being between 99.5° and 102.5°. Eye grounds examination revealed many small hemorrhages in both eyes, associated with arteriosclerotic changes. Electrocardiograph indicated a severe myocarditis. Patient developed a bilateral wrist drop two days after admission, which persisted until death, which took place February 16, 1927.

*Laboratory findings*

| Blood | Feb. 7, 1927 | Feb. 11, 1927 | Feb. 14, 1927 |
|---|---|---|---|
| Red blood cells | 970,000 | 930,000 | 980,000 |
| White blood cells | 3,900 | 3,700 | 4,100 |
| Hemoglobin per cent | 20 | 21 | 33 |
| Color index | 1.05 | 1.13 | 1.6 |
| Polymorphonuclears | 72 | 82 | 77 |
| Lymphocytes | 21 | 13 | 17 |
| Mononuclears | 3 | 0 | 1 |
| Eosinophiles | 4 | 1 | 0 |
| Normoblasts | 2 | 3 | 0 |
| Megaloblasts | 0 | 4 | 3 |
| Myeloblasts | 0 | 3 | 1 |
| Anisocytosis | Marked. | Marked. | Marked. |
| Poikilocytosis | Marked. | Marked. | Moderate. |
| Polychromasia | Yes. | Yes. | Yes. |

*Blood chemistry.*—February 12, 1927: Urea nitrogen, 81; uric acid, 13.2; creatinine, 3.8; sugar, 217. Blood Wassermann, 4 plus; Kahn, 4 plus.

*Urine.*—Examination of four different specimens of urine shows specific gravity ranging from 1.010 to 1.012; negative for albumin and sugar; a few fine granular casts noted in one specimen.

Phenolsulphonephthaline test shows marked diminution kidney function.

Gastric analysis was not performed because of delirious condition of patient.

Death occurred 10 days after admission. Permission for autopsy was obtained and findings were recorded as follows:

The subcutaneous fat was well preserved and tinged a deep lemon yellow.

*Lungs.*—Passive congestion at the bases.

*Heart.*—Fat and flabby; left ventricle hypertrophied; "tigering," marked. Microscopic examination showed fatty degeneration.

*Liver.*—Enlarged and fatty. Microscopic examination showed extreme fatty degeneration.

*Spleen.*—Enlarged and appeared engorged; weight, 330 grams. Microscopic examination showed extreme passive congestion. The engorgement was so extreme as to encroach upon the pathological cellular proliferation, but there were observed many myelocytes, myeloblasts, megaloblasts, and normoblasts. There was pronounced proliferation of eosinophiles.

*Kidneys.*—United in horseshoe fashion. Each one showed rather advanced nephritis. Microscopic examination showed a great proliferation of fibrous tissue replacing tubules and glomeruli. No signs of acute nephritis.

*Aorta.*—Longitudinal striæ noted. Microscopic examination showed degeneration of intima and the adventitia. There are occasional early gummatous foci.

*Stomach.*—The gastric mucosa showed pronounced atrophy grossly and microscopically.

*Bone marrow.*—That of the ribs and right fibula, a little redder than normal but no pronounced changes grossly apparent. Microscopic examination showed numerous erythrogenic centers which were exceedingly cellular. The hyperplasia was much more pronounced histologically than gross examination suggested. Among the erythrogenic centers, megalocytes formed the most prominent part of the picture; in fact, the megalocytes were the predominating cells in the majority of the centers.

Sections of the liver, kidney, and spleen showed a pronounced hemosiderosis as demonstrated by the Prussian blue reaction.

*Anatomical diagnosis.*—Pernicious anemia, syphilis, chronic nephritis.

The unusual feature of this case which seems to merit its report is the association of pernicious anemia with both chronic nephritis and syphilis. Chronic nephritis of slight degree is often found associated with pernicious anemia and positive serological reaction for syphilis is not uncommonly found. However, both syphilis and chronic nephritis, the latter of such severity as to cause death, associated with a true pernicious anemia is a distinct rarity.

Before autopsy the first question brought up was whether we were dealing with a case of pernicious anemia or a severe secondary anemia due to syphilis or nephritis. Syphilis may exceptionally produce a pernicious type of anemia—an anemia which improves on antiluetic treatment and does not recur. Many physicians do not believe a diagnosis of pernicious anemia in the presence of a 4+ Wassermann reaction justified until the therapeutic test has been applied. Stern, of a different opinion, writes as follows:

> It is not surprising to find serological evidence of luetic infection present with pernicious anemia and the association is not surprising in view of the prevalence of syphilis in hospital patients. Whether there is any causal relation between the two is always a pertinent but unanswerable question. Syphilis may be so protean in its manifestations as to present almost any group of symptoms, and it is particularly stated in writings on the subject that it may in fact cause an anemia of the pernicious type. When this occurs, however, it is relatively early in the course of the infection and not associated with late manifestations such as tabes dorsalis. It is the experience of this clinic that pernicious anemia associated with late syphilis is not the result of lues, but is a separate entity and not affected by antiluetic treatment. In fact it usually makes it worse.

Cabot says, "It is not uncommon to find a mild secondary anemia in the course of an active attack of syphilis, but a pernicious anemia in this connection is certainly very rare." The therapeutic test was not tried in our case, but we were evidently dealing with an old case of syphilis, as evidenced by the history of miscarriages, the syphilitic aortitis, and the absence of clinical signs of syphilis.

The frequency of the association of chronic nephritis and pernicious anemia is shown by the following figures. At the University of Pennsylvania, 36 per cent of pernicious anemias at necropsy showed parenchymatous nephritis and 24 per cent showed fatty change. At the Johns Hopkins Hospital, 83 per cent showed renal pathology, the most common finding being tubular degeneration, usually fatty. A mild secondary anemia commonly complicates chronic nephritis and rarely the anemia may become so severe as to resemble pernicious anemia, but in these cases the color index is usually less than one, there are few or no oversized red cells, no nucleated red cells, or only a few normoblasts, and no leucopenia but, rather, a leucocytosis with an increase in polymorphonuclear forms.

The bilateral wrist drop found in this case was thought to be due to uremia, as motor paralyses are not rare in this condition. There was no indication of lead poisoning, which was considered as a possibility before the true diagnosis was established.

Death was probably due to a combination of nephritis and pernicious anemia and, in the absence of the former, it would have been likely that the pernicious anemia would have gone on with its remissions and exacerbations.

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## NEPHRITIC DIAZO REACTION [1]

### WITH REPORT OF CASES

By W. J. N. DAVIS, Jr., Lieutenant (Junior Grade), Medical Corps, United States Navy

This paper consists of a brief discussion of the diazo reaction on blood of patients suffering from chronic nephritis, and the report of three cases of chronic nephritis in whom a positive reaction was found.

Andrewes, in England, while studying the van den Bergh reaction, found that when the protein-free filtrate from the serum of uremic patients was treated with Ehrlich's diazo reagent, a characteristic pink occurred upon its being made alkaline. A short time later Becker, in Germany, also reported positive diazo reactions in certain nephritic cases. He believed that the clinical picture of uremia was not due to the retention in the blood of urea, uric acid, or creatinine, but that the toxicity was due to the retention of certain aromatic amino acids which normally are formed in the intestinal tract and

[1] From U. S. Naval Hospital, New York, N. Y.

excreted by the kidneys. He performed this test on the blood from a number of uremic patients, and in each case a positive reaction occurred. Then, as a control, he performed the test on the blood of non-nephritic patients, and in each case a negative reaction was obtained. Hewitt, in England, improved the technique of Andrewes, and confirmed the specificity of the reaction in cases of uremia and attempted to determine the substance causing the reaction. He came to a conclusion similar to that of Becker, namely, that it was some substance normally formed in the intestinal tract and excreted by the kidneys, but which in cases of marked renal insufficiency was retained in the blood.

Rabinowitch, in Canada, made a clinical study of the value of the diazo color reaction in the differential diagnosis of uremia. His findings confirmed those of Andrewes, Hewitt, and Becker, namely, a positive diazo reaction was found in patients showing marked retention of waste products due to renal lesions such as advanced chronic nephritis. He also found this test positive in cases showing marked retention of waste due to acute surgical conditions of the kidneys.

Blotner and Fitz performed the diazo test on the blood of 700 patients with a variety of diseases, such as diabetes, syphilis leukemia, typhoid, subacute bacterial endocarditis, and also on 100 cases of cardiorenal disease with varying degrees of diminished function who did not have manifestations of chronic nephritis. In no case without renal insufficiency of a marked degree was even a faint reaction obtained. They performed the diazo test on 36 cases of advanced nephritis with marked renal impairment and found the test to be positive in each case. Out of this group of cases 78 per cent died within one year of the time when the test was first found to be positive. Fourteen of these died within 1 to 8 days, five died within 16 to 28 days, six died within 1 to 3 months, two died within 3 to 4 months, and one died within 1 year. The positive diazo test was compared with the findings of the P. S. P. test and the blood urea nitrogen. A positive test was not found in any patient who was capable of excreting more than a small per cent of the dye at the end of two hours. No definite relation was found between the initial positive diazo test and the concentration of the blood urea nitrogen. The following table shows their findings of blood urea nitrogen at the time when the diazo test was first found to be positive:

*Blood urea nitrogen (in mg. per 100 c. c. of blood)*

| Number of cases: | |
|---|---|
| 7 | 28 to 50 |
| 8 | 51 to 80 |
| 10 | 81 to 104 |
| 7 | 105 to 150 |
| 4 | 151 to 250 |

It would be of interest to know what the concentration of creatinine was in each of these cases when the diazo test first was found to be positive. However, we can readily see the value of this test in enabling us to make an early prognosis in a case of chronic nephritis. Blotner and Fitz cite two cases of supposedly chronic nephritis with high-blood pressure and a considerable degree of peripheral arteriosclerosis, urine of low specific gravity with albumen and casts, and high-blood urea nitrogen. Both of these patients showed clinical vascular disease with the renal element as outstanding as the vascular. However, one of these cases showed a positive diazo test while the other gave a negative reaction. The patient with the positive reaction died in a little over a month, while in the case of the patient with the negative reaction, under digitalis and rest, the concentration of the urea nitrogen fell to almost normal and the clinical symptoms disappeared.

### Case Reports

*Case 1.*—D., a Veterans' Bureau patient, 32 years of age, was admitted to the United States Naval Hospital, Brooklyn, N. Y., on March 25, 1927, complaining of vomiting and general weakness. He gave a history of chronic nephritis, starting about 1919, with frequent hospitalization since then, and inability to work for past five years. At one time, he states, he was almost blind. His present trouble started a few months prior to admission, with severe occipital and frontal headaches and blurring of vision, but some relief from this was reported during the past week. Vomiting began a few weeks prior to admission and has become progressively worse until patient is almost unable to keep anything down. Muscular twitchings occurred a few days before admission. Family history is negative; venereal diseases are denied, and patient had not had any serious injuries or operations.

Physical examination revealed an acutely ill white male of about 32 years of age, who was vomiting frequently and had a temperature of 98, pulse of 100, and respiration of 21. Positive physical findings: Skin was yellow, complexion pasty, muscular twitchings. The heart was slightly enlarged to the left, with accentuated aortic second. Blood pressure 160/90. Abdomen revealed slight tenderness to palpation and liver was palpable.

#### LABORATORY FINDINGS

*Urine.*—Straw colored; reaction, alkaline; sp. gr., 1.005; albumin, 3 plus; sugar, negative; and small granular casts.

24-hour specimen of urine showed 6 grams albumin per liter of urine.

*Blood count.*—Red blood cells, 1,870,000; white blood cells, 7,250; hemoglobin, 45 per cent; polys., 69 per cent; lymph., 29 per cent; trans., 2 per cent.

*Blood chemistry.*—Urea N., 90; uric acid, 9.8; creatinine, 22.5; sugar, 115.

*Nephritic diazo reaction.*—Four plus.

The patient continued to vomit after admission to ward, and the muscular twitchings continued in spite of eliminative treatment given. The patient appeared on the verge of uremic convulsions and coma. On March 28 a Murphy drip of 10 per cent glucose solution was started because no nourishment could

be taken by mouth. On the 29th this had to be discontinued because of painful hemorrhoids. The next day brought no particular change in his condition, but the following day, March 30, patient became semidelirious and had frequent convulsive seizures. He died at 2.30 p. m. March 30.

### AUTOPSY FINDINGS

*Urinary bladder* had a diverticulum, apparently congenital, to the inner side of left ureteral orifice. At autopsy the diverticulum was full of urine and compressed the ureter.

*The left kidney* had apparently not increased in size since birth, but showed hydronephrosis on a miniature scale.

*The right kidney* showed advanced chronic nephritis. It was small, untracted, and granular.

*The heart* was hypertrophied but did not show any valvular disease. The aorta showed moderate sclerosis.

*Case 2.*—R., a Veterans' Bureau patient, 27 years of age, was admitted to the United States Naval Hospital, Brooklyn, N. Y., with a diagnosis of chronic nephritis and complaining of headache, with impaired vision and edema of extremities. He gave a history of edema of ankles while in the Army in 1918 and has not been well since then. He has been hospitalized once for a disorder similar to present complaints. Present complaints began about seven weeks prior to admission, with pain in region of the heart and severe headaches, with spots before the eyes. About four weeks later swelling of the feet and lower eyelids, frequent nausea, and occasional vomiting occurred. Nycturia about twice a night has been present for about two months. Family and marital history was negative. All venereal diseases were denied.

Physical examination revealed an anemic-looking white male of about 27 years of age with normal temperature, pulse, and respiration.

*Positive findings were.*—Slight peridental infection of gums. Tonsils chronically diseased. Heart was slightly enlarged to left, with accentuated aortic second sound. Blood pressure, 150/100.

### LABORATORY EXAMINATIONS

*Urine.*—Straw color; acid reaction; specific gravity, 1.010; albumin, 2 plus; sugar, negative; occasional leucocytes and amorphous urate crystals.

*Twenty-four hour urine specimen* (February 9).—Showed 1,500 cubic centimeters excretion with 5 grams of albumin and small granular casts.

*Mosenthal test* (February 10).

| Time | Quantity | Specific gravity | |
|---|---|---|---|
| | *Cubic centimeters* | | |
| 10 a. m. | 35 | 1.020 | Albumin, 1 plus. Total chlorides, 5.2 grams. Total nitrogen, 4.8 grams. |
| 12 a. m. | 75 | 1.012 | |
| 2 p. m. | 100 | 1.011 | |
| 4 p. m. | 80 | 1.012 | |
| 6 p. m. | 155 | 1.012 | |
| 8 p. m. | 150 | 1.011 | |
| 8 p. m. to 8 a. m. | 200 | 1.013 | |

*P. S. P. test:* (February 11):

| | Cubic centimeters | Per cent |
|---|---|---|
| First hour | 100 | 2.5 |
| Second hour | 75 | 2.5 |

*Blood count:*

March 10, red blood cells, 3,410,000; white blood cells, 8,950; hemoglobin, 70 per cent; polys., 70 per cent; lymph., 29 per cent; eosin., 1 per cent.

April 2, red blood cells, 2,800,000; white blood cells, 14,100; hemoglobin, 35 per cent; polys., 79 per cent; lymph., 19 per cent; L. mononuclear, 1 per cent; eosin., 1 per cent.

*Coagulation time*, 3 minutes.

*Blood chemistry:*

February 7, Urea N, 4.1; uric acid, 4.2; creatinine, 5.6; sugar, 130.

April 7, Urea N. 9; uric acid, 10.2; creatinine, 11.2; sugar, 120; plasma $CO_2$, 26.

*Nephritic diazo reaction* (April 7).—Positive, 4 plus.

A few days after patient arrived on the ward, foci of infection were limited to the tonsils. Patient contracted a slight "cold" but soon recovered, and on March 15 his tonsils were removed. About 10 days later, after patient had been sent back to nephritic ward, he had oozing of blood from tonsillar fossae for about two days. From this time on patient did not appear to be doing well and on April 4 he started vomiting. He was placed on the critical list. Blood chemistry at this time showed marked retention and the nephritic diazo test was found to be positive.

During the next week patient continued to get worse in spite of eliminative treatment. He continued to vomit and finally could not take any nourishment by mouth. Murphy drip of 10 per cent glucose solution was then given, but finally patient expelled this. Patient gradually became comatose and died at 7.18 a. m., April 14, 1927.

No autopsy could be obtained.

*Case 3.*—G, a Veterans' Bureau patient, 30 years of age, was admitted to the United States Naval Hospital, Brooklyn, N. Y., with the diagnosis of nephritis, chronic, and complaining of edema of feet and legs, blurring of vision, and nycturia. He gave a history of being gassed in 1918. This was followed by albumin in the urine. About 1920 he had a uremic convulsion—had dyspnea, edema of ankles, headaches, and polyuria for a year previous. His relatives stated that he has had several convulsions since 1920. From that time on, till time of admittance, he had been hospitalized for this condition many times. Was last hospitalized at this hospital and discharged February 27, 1927, in fairly good condition. The concentration of creatinine in the blood was reduced from 5.4 to 2.3. A few weeks prior to admittance this time he noticed rather marked and persistent edema of the feet and legs. Blurring of vision, with almost complete loss of vision in the right eye, and polyuria developed about a week before admission. Epistaxis has been occurring occasionally of late and dyspnea has gradually been becoming more marked. Family history negative, except that father died of carcinoma at age of 49. Medical history, childhood diseases, scarlet fever, tonsillitis, and influenza.

*Accidents.*—Was gassed during war, 1918.

*Operations.*—Tonsillectomy, 1918.

Physical examination revealed an anemic looking white male of about 30 years of age, appearing acutely ill. Temperature, pulse, and respiration were normal. Positive findings:

*Skin* was smooth, moist and pasty in appearance, with puffiness beneath the eyes.

*Heart* was enlarged, tones were clear, snappy, and loud, with accentuated aortic second sound. There was a suggestion of a soft systolic blow at the base. Pulse was regular and full. Blood pressure, 220/129.

*Lungs* revealed a few scattered râles, especially at both bases.

*Extremities* revealed swelling of the feet, ankles, and legs almost to the knees, with slight pitting on pressure.

*Nervous system* revealed fine tremor of the hands and lively reflexes, but no muscular twitchings.

LABORATORY FINDINGS AND SPECIAL EXAMINATION

*Urine* on admission (April 2), straw color; acid reaction; albumin, plus; sugar, negative; numerous leucocytes and small casts.

*P. S. P. test.*—April 5, first hour, no color change; second hour, no color change.

*Mosenthal test.*—(Ringer modification.) April 5.

| Time | Quantity | Specific gravity | |
|---|---|---|---|
| | *C. c.* | | |
| 10 a. m. | 60 | 1.011 | Albumin, 2 plus. Total chloride, 4 grams. Total nitrogen, 2.6 grams. |
| 12 noon | 125 | 1.011 | |
| 2 p. m. | 65 | 1.012 | |
| 4 p. m. | 75 | 1.011 | |
| 6 p. m. | 60 | 1.011 | |
| 8 p. m. | 100 | 1.011 | |
| Total | 485 | 0.001 | Fluctuation. |

Night.—8 p. m. to 8 a. m., 160 cubic centimeters, 1.011. (This small amount appears, as all the night urine was not collected.) Albumin, 1 plus. Total chloride, 1.3 grams. Total nitrogen, 3.2 grams.

*Blood count.*—Red blood cells, 2,210,000; white blood cells, 8,950; hemoglobin, 50 per cent; polys., 70 per cent; lymph., 27 per cent; trans., 1 per cent; eosin, 2 per cent.

*Blood chemistry.*—

April 4: Urea N., 28; uric acid, 4.2; creatinine, 3.7; sugar, 88; plasma $CO_2$, 30; nephritic diazo reaction, negative.

April 12: Urea N., 75; uric acid, 4.5; creatinine, 9.0; plasma $CO_2$, 20; nephritic diazo reaction, positive; van den Bergh, negative.

*Eye examination.*—April 2: V. O. D., 2/20+J 5; V. O. S., 16/20+J iii.

There is definite albuminuric retinitis in both eye grounds and numerous hemorrhagic spots, especially in left background.

Patient's condition remained about the same as on admission, April 1, 1927, until April 9, 1927, when he began to complain of extreme nervousness and twitching in both legs. His vision had been practically nil since his eyes were dilated. He had frequent attacks of epistaxis and on April 11, 1927, he began vomiting and appeared much worse. Nausea and vomiting persisted in spite of eliminative treatment, and a Murphy drip of 10 per cent glucose solution was given in the hope of keeping up nutrition. This, however, soon had to be stopped, as patient would expel it immediately and diarrhea would continue

for several hours. Patient gradually became worse and was stuporous for the last few days. He became comatosed about April 16, 1927, and that night Cheynes-Stokes respiration was observed. The next morning a marked pericardial rub was heard and patient died that afternoon, April 17, 1927, about 4.20 p. m.

AUTOPSY FINDINGS

*Lungs.*—Both showed edema and passive congestion.

*Heart.*—The pericardial sac contained about 150 cubic centimeters of clear fluid. Over the pericardium were a few areas covered by a fibrinous exudate. The heart was considerably hypertrophied and weighed 470 grams. The endocardium and valves were negative. The aorta showed moderate sclerosis. Liver and spleen showed passive congestion.

Lower ileum and the colon were hemorrhagic and acutely inflamed.

Kidneys were both granular and contracted, with cortex in each less than 1.5 millimeters, and pelvic fat increased. The capsule stripped with difficulty and left a distinctly granular surface. Fibrosis was pronounced throughout the kidney substance.

Adrenals, pancreas, prostate, and urinary bladder appeared negative.

## VIEWING STAND AND RADIO INSTALLATIONS FOR THE OPERATING ROOM [1]

By A. FARENHOLT, Captain, Medical Corps, United States Navy

A viewing stand of somewhat different proportions than those shown in dealers' catalogues being required for use in the operating room of this hospital, a very suitable and sightly one was constructed by hospital labor, using iron pipe and pipe fittings and a wooden flooring. The stand accommodates five observers on each of the two decks, and it is possible to move it to any position which may be required in order to obtain a different viewing angle or for other purposes.

The two floors are made of 1-inch oak plants, 1 foot 8 inches wide by 8 feet long, cut to fit, and secured only by their own weight. These planks are oiled and may be removed for cleaning. Each deck has a seat running the entire length made of two rows of pipe.

The frame is composed of 1¼-inch ball pattern malleable-iron rail fittings and black iron pipe, and is of the following dimensions:

| | Ft. | In. |
|---|---|---|
| Length | 8 | |
| Height of back | 6 | 9 |
| Height of front | 4 | 8 |
| Total width | 3 | 3 |
| Width of each deck | 1 | 8 |

[1] From U. S. Naval Hospital, Great Lakes, Ill.

The separate parts, used in the assembly, are technically described as follows:

*Fittings—1¼-inch ball rail*

| | Pieces |
|---|---|
| Standard elbows | 10 |
| Standard tees | 10 |
| Standard side opening tees | 10 |
| Side-opening tees with side-opening left thread | 6 |
| Standard crosses | 4 |
| Standard side-opening crosses | 8 |
| Side-opening crosses with side-opening left thread | 8 |

*Pipe—Black iron 1¼ inch*

| | Pieces |
|---|---|
| 40-inch long right-hand thread, both ends | 2 |
| 40-inch long right and left hand thread | 2 |
| 29-inch long right-hand thread, both ends | 20 |
| 29-inch long right and left hand thread | 32 |
| 25½-inch long right-hand thread, both ends | 2 |
| 25½-inch long right and left hand thread | 2 |
| 23¼-inch long right-hand thread, both ends | 2 |
| 23¼-inch long right and left hand thread | 2 |
| 22-inch long right-hand thread, both ends | 2 |
| 22-inch long right and left hand thread | 2 |
| 17-inch long right-hand thread, both ends | 8 |
| 17-inch long right and left hand thread | 8 |
| 13¾-inch long right-hand thread, both ends | 2 |
| 13¾-inch long right and left hand thread | 2 |
| 11½-inch long right-hand thread, both ends | 2 |
| 11½-inch long right and left hand thread | 2 |
| 10-inch long right-hand thread, both ends | 4 |
| 10-inch long right and left hand thread | 4 |
| 8½-inch long right-hand thread, both ends | 4 |
| 8½-inch long right and left hand thread | 4 |

The accompanying photograph shows the stand as at present installed. This photograph also shows the use of radio in the operating room. This accessory was easily installed and has been in use here for some months. It has proved to be of considerable value in certain cases operated upon under a local anesthetic.

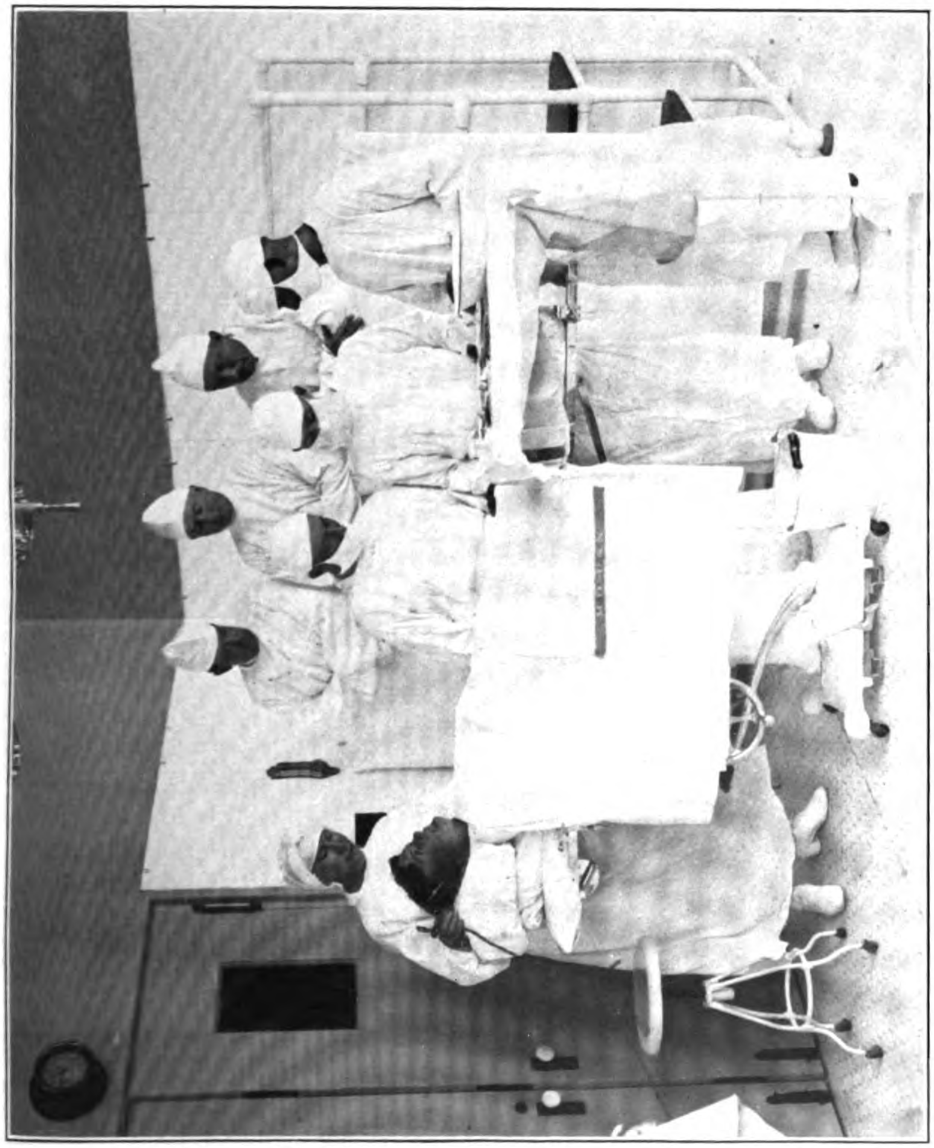

FIG. 1.—VIEWING STAND AND RADIO INSTALLATIONS FOR THE OPERATING ROOM

# THE NAVAL RESERVE

## THE VOLUNTEER RESERVE

### Medical Corps for General Service

*Training is voluntary.*—Men under 31 years of age are eligible for appointment in this class. Assuming that the medical man is physically qualified, he is appointed lieutenant (junior grade), MC–V (G), United States Naval Reserve. He is required to do nothing, but he may request training duty of 15 days each year. For this he may or may not be paid; if travel is involved, he may or may not be paid mileage. This will be explained below. All that need be said at present is the fact that all is voluntary; under the law, in time of peace, the deciding authority is the individual himself. Why, then, should he care or trouble himself about training duty? Leaving such abstract, and yet very real, considerations as pleasant associations out of the question, it may be said that a desire for promotion prompts the young officer to request training duty. Six periods of training duty—one each year—will make him eligible for promotion to the rank of lieutenant.

*Higher pay for reserve officers.*—However, for the sake of illustration, let us assume that the young man has not raised a finger, that 18 years have rolled by, when suddenly the country finds itself in a national emergency. A classmate who is qualified to do general practice is appointed at this time, also a lieutenant (junior grade). Another classmate who has become an outstanding specialist is commissioned a lieutenant commander in the specialists' class. Yet the man who has done nothing but hold his commission during the course of years receives a higher base pay than either of the above-mentioned classmates. The man just appointed lieutenant (junior grade) receives a base pay of $2,000, the one just appointed lieutenant commander receives $3,000, while the lieutenant (junior grade) with 18 years' service receives $3,120. In addition, each receives rental and subsistence allowances for himself and dependents, if he has any. However, in case of such a national emergency, there would be an expansion of the naval service and promotion would become rapid immediately, so that even our rather neglectful friend would become at least a lieutenant and, in consideration of 18 years of "service,"

would receive a base pay of $3,900 instead of the $2,400 he would get had he no such "service" to his credit when he received his promotion to rank of lieutenant.

Again, for the sake of illustration, let us assume the young man is determined to forge ahead. And let us assume further the highly improbable possibilities of a Congress through a long series of years turning a deaf ear to the insistent demands of the country for increased appropriation for training of the United States Reserve Forces. Let us also assume that the young man's application for training arrives each time after all the limited funds have been obligated. He is determined, and also knows the stimulating effect of a change of environment and interests.

He requests and claims permission to report for a two-weeks' period of training at a naval hospital of his own choice, and motors over to spend part or all of his vacation thus. He receives no pay. Yet he gets in touch with hospital work, spends a pleasant two weeks, and receives credit for the training period. In six years, he receives a promotion to the rank of lieutenant, and in six more to lieutenant commander. At the end of 18 years he is high up on the list of lieutenant commanders, and, when selected to be a commander, his 18 years of service will make a favorable impression on his pay check. But the assumption that a man would be taking training year after year without expense to the Government is extreme and improbable. He would soon learn that his application might be sent to the commandant early in the year, before the limited funds are obligated. He would thus get his training with pay and, in a great many instances, when distances traveled were not too great, would receive his mileage also. And, of course, the more the reserve officers want training, the more funds will Congress be persuaded to appropriate. And as the country realizes how dependent it is for its welfare in peace and war on a strong Navy, Congress will become convinced of the wisdom of this form of insurance and will appropriate larger amounts for training of naval reserves.

*With or without pay.*—In this connection, it might be well to explain why officers of the reserve perform training duty sometimes with pay, at other times without pay; why sometimes mileage is paid and at other times not.

Congress appropriates a certain sum of money for the training of the Fleet Naval Reserve. Over and above this amount an additional small sum is appropriated for training the Volunteer Reserve. Only a portion of this second sum is available for training of the medical officers. As the applications are received by the commandant, he grants the training duty with pay as long as the money lasts. Any further applications can only be granted without expense to the

Government, there being no more money available. Nor would it be to the best interests of the service to spend for mileage of one officer residing at a great distance a sum which could pay the mileage of two officers residing nearer.

There are times when a reserve officer can not be permitted to perform training duty without pay, even though he may be willing to pay his own transportation. It is thus when all the available facilities are already taxed to the utmost.

*Eligible for transfer to Fleet Reserve.*—The medical officer in the Volunteer Reserve is eligible for transfer to the Fleet Reserve whenever there is a vacancy in the Fleet Reserve in his vicinity.

Promotion to the next higher rank in the Fleet Reserve may take place in four years. (See below under Fleet Reserve.)

*Precedence advantages.*—H–1710 (Naval Reserve Regulations). In time of peace, officers of the Naval Reserve shall take precedence with but after officers of the same rank or grade in the regular Navy. When mobilized with the regular Navy for war or national emergency, officers of the Naval Reserve shall, for the duration of the war or national emergency, take precedence after the junior of their respective ranks or grades in the regular Navy on date of such mobilization. Officers of the Naval Reserve of and above the rank of lieutenant commander, who are selected for advancement in accordance with the provisions of article H–1721, shall, when so advanced, take precedence during the then existing war or national emergency with officers of the regular Navy of the same rank or grade in accordance with the dates stated in their commissions.

H–1721. (1) In time of war or national emergency, officers on the active list of the Naval Reserve employed on active duty shall be advanced in grade and rank up to and including the rank of lieutenant commander with the officers of the regular Navy with whom or next after whom they take precedence in accordance with this act, and such officers of and above the rank of lieutenant commander shall be eligible for selection upon recommendation by a board appointed, constituted, and approved as required by law for the regular Navy, and when so selected shall be eligible for advancement, either temporary or permanent, to the next higher grade or rank in the Naval Reserve corresponding to such higher grades or ranks as may then exist on the active list of the regular Navy, in such numbers for each grade or rank as may be prescribed from time to time by the Secretary of the Navy.

(2) No officer of the Naval Reserve shall be advanced to a higher rank until he has qualified therefor by such mental, moral, professional, and physical examinations as the Secretary of the Navy may prescribe.

(3) All officers of the Naval Reserve who may be advanced to a higher grade or rank shall be allowed the pay and allowances of the higher grade or rank from the dates stated in their commissions.

(4) The provisions of this article shall not apply to officers who have been or may hereafter be retired from the Naval Reserve Force or the Naval Reserve.

### Former Commissioned Officers of the Regular Navy

*To retain date of rank.*—These, when appointed in the Volunteer Naval Reserve, retain the same date of rank in their reserve commission which they had in the regular Navy, if appointed in the reserve

within four months of their separation from the regular Navy. They may be transferred from the Volunteer to the Fleet Reserve with the permanent rank held by them in the regular Navy.

*Promotion advantages.*—After the time served in a grade in the regular Navy and in the reserve amounts to six years (in case of lieutenant (junior grade) and lieutenant), these officers may be recommended for promotion. Each case is decided on its merits. For example, a man who served his interne year in a naval hospital, then resigned, applied for appointment, and was appointed in the Volunteer Reserve and did nothing more, when applying for promotion would not be likely to be recommended for promotion. But, if during the five years following his service in the regular Navy, he had completed at least two training periods in the Naval Reserve, the bureaus concerned would feel that he was seriously interested in the naval service and would most likely recommend that he be promoted.

*Entitled to uniform gratuity.*—If transferred to Fleet Naval Reserve, he is paid uniform gratuity; also, if called to active duty in time or war or national emergency. (See details under Fleet Naval Reserve.)

*Precedence advantages.*—H-1709 (Naval Reserve Regulations). Former officers of the Navy or Coast Guard who, within four months of separation therefrom, are appointed in the Naval Reserve after July 1, 1925, in the same ranks or grades as last held by them in the Navy or Coast Guard, shall take precedence among themselves and with other officers of the Naval Reserve according to the dates of the commissions or warrants held by them in the Navy or Coast Guard when separated therefrom.

### MEDICAL CORPS FOR SPECIAL SERVICE

*Membership.*—This class is composed mostly of specialists who are members of organized units. In case of a national emergency, each man in these groups will continue to follow his specialty and will go everywhere with his unit, his associates in civil life. His position in the Navy organization is relatively fixed and, in case of war, he will not be subject to confusion and chance as will his civilian colleague. He holds a certain rank and is sure that he will hold at least that rank, and will probably be given a higher one shortly after being called to active duty. His years of service which he has accumulated by holding a commission in the Naval Reserve will place him in a higher pay period than his colleague who may be appointed from civil life at the time—assuming that the civilian will receive as high a rank, which is unlikely.

*Promotion.*—H-3502 (Naval Reserve Regulations). In time of peace special-service officers will be eligible for promotion to the next higher rank or grade, but not above lieutenant commander, only when in their professional attainments they have made such a marked increase as would justify a commission in the higher rank or grade if they are being appointed in the reserve for the

first time. They must be recommended for promotion by the appropriate bureau or office under whose cognizance they would come in war time. The decisions as to whether they are entitled to promotion or not will be a function of the Naval Examining Board.

In time of war promotion is in accordance with paragraph 1, H-1721, Naval Reserve Regulations. (See under "Precedence advantages, Volunteer Reserve medical corps for general service.")

*Training and pay.*—No training is required. These officers, being carried for duty as specialists, will be expected to follow their specialty in which already trained. They receive no pay in time of peace, as a rule, but may be ordered to training duty with pay upon their own request.

*Social advantages.*—These groups may hold social gatherings, give dinners, etc., at which comradeship and esprit de corps may be fostered. If in vicinity of naval hospitals they may find much of common interest with the regular staff of the hospital.

*Appointment.*—All appointments or transfers are only at the foot of the list of lieutenants, junior grade, except in case of former medical officers of the regular Navy, who may be transferred from the Volunteer Reserve with the permanent rank held by them in the regular Navy. These are carried on precedence list as extra numbers, and do not block the promotion of other reserve officers.

*Training required and pay therefor.*—In time of peace officers of the Fleet Naval Reserve * * * shall perform 15 days' training duty each fiscal year unless excused therefrom for good and sufficient reasons. For this period they receive the same pay as an officer of the Regular Navy of the same rank and length of service. For each drill or period of appropriate duty not to exceed 60 days in one year a lieutenant or lieutenant, junior grade, receives one day's pay. Officers above the rank of lieutenant who satisfactorily perform not less than four periods of appropriate duty during any full calendar month shall receive compensation at the rate of $500 a year.

*Uniform gratuity.*—Upon being appointed in the Fleet Naval Reserve, an officer shall be paid $100 for purchase of required uniforms and thereafter he shall be paid an additional sum of $50 for the same purpose upon completion of each period of four years in the Fleet Naval Reserve. In time of war or national emergency, a further sum of $150 for purchase of required uniforms shall be paid to officers of all classes of the Naval Reserve when they first report for active duty.

## THE FLEET RESERVE

*Promotion.*—For purposes of promotion the officers of the Medical Corps are arranged in a precedence list in the order of their seniority and from the grade of lieutenant commander down are promoted in

this order to fill vacancies in the various grades. The total number, exclusive of extra numbers, shall be distributed in the proportion of 16 in the grade of lieutenant commander, to 37 in the grade of lieutenant, to 47 in the grade of lieutenant, junior grade. To be eligible for promotion the officer must have performed 60 days' active or training duty in the grade in which serving, and must have not less than 4 years' service in the grade of lieutenant, junior grade, or lieutenant, as the case may be.

### HIGHER GRADES OR RANKS AUTHORIZED

The number of officers who may be carried in these higher grades is the combined number in all classes of the Naval Reserve: Fleet, Merchant Marine, and Volunteer.

For recruiting, organization, administration, training, inspection, and mobilization of the Naval Reserve, the following percentages of officers in the higher grades or ranks are authorized:

In the staff, twenty-four one-hundredths of 1 per cent of the actual number of enlisted men regularly assigned to divisions or other organized units of the Fleet Naval Reserve who are entitled to pay. The total number of staff officers shall be equally divided in each grade, as nearly as may be, between the Medical Corps and the Supply Corps. The actual number of staff officers so commissioned in higher ranks shall be commissioned in the proportion of 8 in the rank of captain to 16 in the rank of commander.

It will be seen that any increase in the size of the Naval Reserve will create vacancies in the upper grades, so that promotions to those grades may take place much earlier than might be expected from a superficial inference.

### IDENTIFICATION

*Leaving United States.*—Commandants of naval districts are authorized to approve requests from officers and enlisted men of the Naval Reserve for permission to leave the United States or its possessions. Members of the merchant marine Naval Reserve will not be required to obtain permission on each trip, while following their professions in the merchant marine, but should keep the commandant advised of their occupation and addresses.

*Passports.*—Members of the Naval Reserve who leave the United States to visit foreign countries where it is necessary to have passports should forward a copy of their authority to leave the United States to the State Department with their applications for passports.

*Advantages.*—While these provisions are primarily for the convenience of the Government, the reserve officer benefits by them.

Should his citizenship be in question or his passport lost, his identity can quickly be established by any consul or diplomatic representative of the United States by furnishing the Navy Department such details as date of birth, date of his commission, his height and weight.

### CHARACTER OF TRAINING DUTY

In the Bulletin of the St. Louis Medical Society, of October 6, 1927, under the heading, "What we saw in a Navy hospital," the editor, Dr. R. B. H. Gradwohl, a lieutenant commander in the Medical Corps of the volunteer general class, United States Naval Reserve, presents the point of view of the reserve officer. For the benefit of those who can not refer to the original, it is given in full below:

It may be interesting to learn a Navy Medical Reservist's impressions of a modern United States Navy hospital. We did our yearly 15 days' tour of duty last summer at the United States Navy hospital at San Diego, Calif.

Reporting for duty at the district commandant's headquarters near the harbor front of this banner city of southern California, we were instructed to take bag and baggage to the hospital, which is situated on land donated to the Government by the city of San Diego, adjacent to beautiful Balboa Park (just as if a hospital were located in the heart of our own Forest Park). Upon a high eminence stands sentinel-like a three-story building, of stuccolike finish and red-tiled roof, about a half city block long, commanding a panoramic view of the city and harbor. A long ravine slopes in front. Passing the Marine guard at the gate we note the well-trimmed lawns and immaculately kept sidewalks—not a speck of dirt, not a sign of refuse—all in true Navy spotlessness and ever maintained so through the never-ending vigilance and inspection of the efficient "exec.," Captain May. Entering the building one runs the usual Navy gauntlet of the officer of the deck, the executive officer, and finally into the august presence of the commanding officer, Capt. Raymond Spear. While Captain Spear—if we may be pardoned for going into personalities—is all that a Navy captain should be—an officer and a gentleman—he is genial and kind, and affable, and quickly makes one feel at home. In the consultation room he is a keen and accomplished diagnostician, and in the operating theater as capable a surgeon as we have had the opportunity of meeting elsewhere. But let us go in. We find that this is a quadrangular building of Spanish type of architecture truly becoming the geography and climate of the place. In a large patio, traversed by flower-bordered walks, there stands a beautiful water fountain, also surrounded by growing plants and flowers.

Back of the main building are service buildings, morgue building, electrical department, garage and Red Cross buildings, nurses' quarters, etc. The hospital has its medical departments divided off in the usual fashion, its surgical wards, one wing devoted to urology, first floor to venereology and second floor to surgical urology. At one end of the quadrangle on the first floor is a completely equipped radiological department with apparatus for both diagnostic and therapeutic purposes. The second floor of this building houses the clinical laboratory, complete in every detail. Directly facing this at the other end of the quadrangle stands the surgical department with operating theater. Just beyond is the orthopedic department. Communication from one part of the building to the other is accomplished along a porticolike structure running outside each floor. The medical department is officed directly over the main

entrance, with a very complete medical library and attendant for same. In this room is held the weekly conference of the medical staff.

At each patient's bed is a radio attachment, furnished by the Red Cross, with a headpiece so that every patient could entertain himself with the radio at all times. In one building there is a radio-control man who is constantly on duty.

We have only sketched the bare details of the building. Just to the south a large addition is now under construction which will house a few hundred more patients. The present bed capacity is approximately 700. The patients come from the enlisted personnel of the training station, from the Marine base, from the destroyer base, from the naval air station, from the Pacific Fleet when in or near San Diego, from the Army, Navy, and Marine retired officer and enlisted group living in or near San Diego, and from the local Veterans' Bureau. In passing, it may be added that there is a large out-clinic department, with a half dozen medical officers devoting all their time to same, caring for the Navy families of the city, which run into several thousands.

The staff is organized as follows: A commanding officer, an executive officer, chief of surgery, medicine, urology, orthopedics, radiology, clinical laboratory, oto-laryngology, neuropsychiatry, dentistry. The staff is highly specialized, all heads of departments having been well trained in their specialties. One officer has charge of the electrocardiogram with proper assisting personnel. The departments with which the writer came most intimately in contact were the laboratory, radiology, and urology. The laboratory was in charge of Lieut. Commander H. S. Sumerlin, a very capable and painstaking pathologist. He has a very well trained staff. The laboratory work is quite extensive. Reports show around 4,000 laboratory specimens per month. This means a tremendous amount of time and skill. Routine blood pictures, serology, and urines are performed on every patient.

The radiological department is in charge of Capt. T. W. Raison, well known among radiologists as a man of vast experience and judgment. Urology is in charge of Commander H. A. Garrison, who is intensely interested in diagnosis and treatment of these diseases. Complete cystoscopic rooms permit him to go over these patients in the customary complete manner of the trained urologist. Lieut. Commander O. R. Goss has charge of oto-laryngology. His department is very capably handled and an enormous amount of operative work is admirably performed.

The "youngsters" of the staff are all junior lieutenants or internes. Under the arrangements introduced into the Navy Department by Surgeon General Stitt a few years ago internes are selected from the class A medical schools, given one year's training with pay, etc., of above rank, with the privilege of remaining in the Navy at the expiration of their internship. A large percentage elect to remain. At the end of the year, if they remain in the Navy, they are sent out on ships for sea duty or to our far-flung island stations for tropical medical training, in places such as Guam, Manila, or China. Instead of the rather obsolete and unsatisfactory method of recruitment of medical officers of former days, we are now getting the best material possible to build up this service. These internes get wonderful training under most ideal conditions. Naturally these positions are much sought after and are obtained only after rigid medical and physical examinations.

The "intermediate staff," or officers between the chief grade and the internes, are medical men who have been in the service from 5 to 10 years. These men are very much on their toes at all times.

There is a medical and surgical conference every Thursday afternoon at which medical and surgical cases are presented with full discussions by all present.

In addititon to all these facts we noted a most intimate contact between the Navy and the civilian medical contingent of San Diego. Frequent visits back and forth between military and civilian hospitals are productive of much technical good and conduce to a delightful bon camaraderie. Just prior to our being detached, the San Diego Medical Society members were the guests of Captain Spear and his staff at a delightful dinner and medical meeting at the hospital. The program was furnished by the staff of the hospital. It covered a very wide field. Cases were presented with histories and proper comments. Captain Spear showed a half dozen goiter cases successfully operated; other members showed a gunshot wound of shoulder joint, staghorn kidney-stone removal; liver diet in a case of pernicious anemia; electrocardiogram of myocardial changes in rheumatic fever; case of typhoid fever; and the writer was honored by a place on the program. The material presented was, if anything, excessive. But it showed the character of the work done by the staff.

As we left the building and stood on the steps looking out into the wondrous California night we saw down in the harbor our ships at anchor, with their winking signal lights at their mastheads; far off the lights of a ship, possibly a destroyer, moving slowly up the harbor to her anchorage. Thoughts filled our mind that here, indeed, was an institution of which the public and the profession both might well be proud; that the Medical Corps of the United States Navy was fast coming into its own; that a Navy hospital, like a Navy ship, was as good as anything in the world of its kind and that a Navy doctor was entitled to stand side by side with a civilian doctor as capable and efficient as the best of them. We left the ship, "shoved off" as they say in the service, and departed homeward, with genuine pleasure at the opportunity of having surveyed this place and these people, very grateful for their courtesy, and very proud to be a "citizen soldier" comrade of this corps élite.

*Recent appointments*

| Name | Rank | Class | Date appointed |
|---|---|---|---|
| Burden, Verne Gerard | Lieutenant | MC-V (S) | Sept. 27, 1927 |
| Cancelmo, Jesse James | Lieutenant | MC-V (S) | Aug. 1, 1927 |
| Gelber, Maksymiljen Robert | Lieutenant (junior grade) | MC-V (G) | Aug. 15, 1927 |
| Gilman, Philip Kingsworth | Lieutenant commander | MC-V (S) | July 28, 1927 |
| Jablons, Abraham | Lieutenant | MC-V(G) | Sept. 27, 1927 |
| Johanson, Nils August | Lieutenant commander | MC-V (S) | Aug. 22, 1927 |
| Keenan, Andrew J | Lieutenant commander | MC-V (S) | Sept. 12, 1927 |
| Kinney, Willard Neil | Lieutenant commander | MC-V (S) | Sept. 27, 1927 |
| Klopp, Edward J | Lieutenant commander | MC-V (S) | Aug. 1, 1927 |
| McCarty, Arthur Clayton | Lieutenant (junior grade) | MC-V (G) | Sept. 27, 1927 |
| Oldenburg, Ray W | Lieutenant (junior grade) | MC-V (G) | Aug. 6, 1927 |
| Schier, Anton Robert | Lieutenant | MC-V (G) | Aug. 15, 1927 |
| Sender, Arthur C | Lieutenant commander | MC-V (S) | Sept. 27, 1927 |
| Sweeney, John Augustin | Lieutenant | MC-V (S) | July 28, 1927 |

*Transfers*

| Name | Rank | From class— | To class— | Date |
|---|---|---|---|---|
| Kramer, Emil Francis | Lieutenant (junior grade). | MC-V (G) | MC-F | Sept. 26, 1927 |
| McGranahan, James Henry | Lieutenant (junior grade). | MC-V (G) | MC-F | Aug. 31, 1927 |
| Roberts, Madison Hines | Lieutenant | MC-F | MC-V (G) | Sept. 3, 1927 |

# NURSE CORPS

## HISTORY OF NURSING IN THE NAVY

By J. BEATRICE BOWMAN, Superintendent, Navy Nurse Corps

### FOREWORD

By way of interest a few words about the establishment of the Bureau of Medicine and Surgery are recorded. The act of August 31, 1842, Chapter CCLXXXVI, Statute 5, page 579, is in part as follows:

SEC. 2. *And be it further enacted*, That there shall be attached to the Navy Department the following bureaus, to wit:

1. A Bureau of Navy Yards and Docks.
2. A Bureau of Construction, Equipment, and Repairs.
3. A Bureau of Provisions and Clothing.
4. A Bureau of Ordnance and Hydrography.
5. A Bureau of Medicine and Surgery.

SEC. 3. *And be it further enacted*, That the President of the United States, by and with the consent of the Senate, shall appoint * * * from the surgeons of the Navy a Chief of the Bureau of Medicine and Surgery, who shall receive for his services two thousand five hundred dollars per annum.

SEC. 5. *And be it further enacted*, That the Secretary of the Navy shall assign and distribute among the said bureaus such of the duties of the Navy Department as he shall judge to be expedient and proper; and all the duties of the said bureaus shall be performed under the authority of the Secretary of the Navy, and their orders shall be considered as emanating from him, and shall have full force and effect as such.

It will be noted that the only bureau that has suffered no change in title is the Bureau of Medicine and Surgery. It is also noted that the Bureaus of Engineering, Navigation, and Aeronautics, and the Office of Naval Operations were not created among the original bureaus.

The first Chief of the Bureau of Medicine and Surgery had no rank conferred upon him by virtue of his office, and he did not have the title of "Surgeon General of the Navy." The first chief of this bureau was William Paul Crillon Barton, a surgeon in the Navy, who served as chief from September 2, 1842, to April 1, 1844. The first Surgeon General of the Navy and chief of the bureau was William Maxwell Wood, who served as chief of the bureau from July 1, 1869, to October 31, 1871. From March 3, 1871, to October

31, 1871, he had the title of Surgeon General of the Navy and the relative rank and pay of commodore. William Knickerbocker Van Reypen was the first Surgeon General of the Navy to have the rank of rear admiral and the pay and allowances of brigadier general. William Clarence Braisted was the first Surgeon General of the Navy to have the rank of rear admiral and the pay and allowances of major general.

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In 1811 the Secretary of the Navy asked Doctor Barton, a surgeon in the Navy, who afterwards became the first Chief of the Bureau of Medicine and Surgery, "to throw together on paper such ideas as he entertained respecting the proper and systematick mode of conducting hospitals and institutions for the sick." The Secretary had been asked to prepare a report for the next meeting of Congress but felt that a medical man was more competent to treat the subject. Doctor Barton prepared his paper for the Secretary, but, as the time was short, it was not so complete as he wished. A little later, when he had more time, he amended the paper somewhat and made numerous additions to it. In 1814 it was published under the title of "A Treatise Containing a Plan for the Internal Organization and Government of Marine Hospitals in the U. S., together with a Scheme for Amending and Systematizing the Medical Department of the Navy." A copy of this book is in the Bureau of Medicine and Surgery and is treasured very highly. It is full of valuable and historical information.

Doctor Barton was a young surgeon and a perfect novice in the routine of ship duty. He had but recently left the Pennsylvania hospital, where everything was systematized and order and routine made the practice of medicine a pleasure. It distressed him very much to find that the ships of the Navy were so poorly equipped to care for the sick and he felt that the work of the Medical Department was of very little account because of the lack of supplies of all kinds, and even lack of suitable space for the sick men. He communicated his discouragement to some of his fellow officers aboard ship and expressed the feeling that he no longer wished to continue as their medical attendant if conditions were to be so deplorable. He received much encouragement from the officers and every effort was made to procure the necessary comforts for the care of the sick. In the preface of his book he states, "In this situation on board of a ship just refitted, commissioned, and equipped, I found myself without half the comforts and necessaries for the sick that the hospital department should have been supplied with; yet this department had been reported as replenished with every requisite article for a cruise of two years, and, together with the medicine chest, had

cost the Government $1,500. There were neither beds for the sick, sheets, pillows, pillow cases, nor nightcaps—nor was there a sufficiency of wine, brandy, chocolate, or sugar; and that portion which the storeroom contained of these articles was neither pure nor fit for sick men."

With the aid rendered by the officers aboard ship who could understand his feelings, many improvements were made, and he states, "I was not long concluding, that if proper steps were taken to furnish the ships with sick necessaries of a proper kind, the practice of medicine and surgery in the Navy, could be rendered not only more beneficial to the sick, but less offensive to the humane feelings of the medical officer."

There were no naval hospitals at the time Doctor Barton wrote his treatise but he made many recommendations concerning them. Even as long ago as this, 1811, he recommended that among the officers of the hospital, nurses should be included. Of them he says:

> The nurses, whose number should be proportionate to the extent of the hospital, and number of patients, should be women of humane dispositions and tender manners; active and healthy. They should be neat and cleanly in their persons; and without vices of any description. They should reside in small convenient apartments adjoining the wards they belong to. They are to attend with fidelity and care upon all the sick committed to their charge; should promptly obey their calls, and, if possible, anticipate their reasonable wants. They should administer all medicines and diets prescribed for the sick, in the manner and at the times specified in their directions. They should be watchful of the sick at all hours, and should, when required, sit up with them at night. They should attend the physician and the surgeon in their visits to the wards. to give information respecting the patients, and to receive orders and directions. They should make all the beds, and keep the wards clean and should report to the assistant physician and surgeons' mates, whenever it is necessary to have them washed; and should not wet them, when they think proper, for the sake of the sick, to omit it at that time. They should report all sudden changes in the disorders of the sick, and all deaths, immediately to the assistant physician or surgeons' mates. They should obey punctually all orders from their superiors; and should exact a ready acquiescence in their commands, from the attendants under them.

When it is considered that Florence Nightingale, whose history needs no comment, was not born until 1820, the remarkable foresight of Doctor Barton in recommending, as early as 1811, that nurses be included among the officers of the hospital is astonishing indeed. After all, more than a century later his ideas of what nurses should be and do are not at all ludicrous, and one can easily detect to-day in the progress or evolution of the nurse that nurses need and should have the same qualifications and ideals as a foundation of all nursing work that Doctor Barton deemed necessary at that time.

In the early history of the Navy afloat, the care of the sick and injured devolved upon the surgeon and the surgeon's mate, with the

assistance of members of the crew. The designation of the helper was changed from time to time, and he was a man of no special training or experience in the care of the sick. Some of the older retired men tell of very thrilling experiences at the hands of these appointed nurses, who, after all, having had no teaching in that line of work, could not be expected to be a finished product.

The discipline in military and naval hospitals has been of great help in the care of the sick. The patients are expected to help in every way possible, and in Doctor Barton's book he recommends certain rules for the government of the patients. The first ones are interesting and amusing—

> Every patient in the hospital shall be obliged to wash his face and hands and comb his hair before breakfast. Those patients who are unable to perform this ablution themselves must be assisted in doing it or have it done for them by their neighbor patients or nurses of the ward. Such patient must be washed with lukewarm water.
>
> If any convalescents or pensioners neglect or refuse to perform this process, the nurse must deny them their breakfast until it is done.
>
> All patients in the hospital shall be obedient to the proper and legal orders of the nurses, assistant nurses, ward master, steward, matron, and indeed all persons in authority.
>
> It shall be the duty of patients in a sick ward to reciprocate and interchange with their fellow patients and sufferers in disease, such little offices of kindness, humanity, and attention, as they may be able to afford for the comfort and convenience of the whole.

Conditions improved gradually in the nursing work of the Navy, but it was not until June 17, 1898, that an organized nursing unit was established by act of Congress. This unit was called "The Hospital Corps of the United States Navy," and its designation is the same to-day. The growth and development of the Hospital Corps has been gradual, but sure, and to-day this corps is one of which the Bureau of Medicine and Surgery has every reason to be proud. It earned for itself an enviable record during the World War and its members were in the front ranks at every battle, or wherever there was any action. Over 60 per cent of the Hospital Corps of the Navy serving with the marines overseas were decorated, either by the French, English, Belgium, Italian, or their own Government. Not only in the Navy is the Hospital Corps known, but it has a splendid reputation in the nursing world. The training schools at Portsmouth and Mare Island are recognized and the graduates are eligible for registration in their respective States, Virginia and California, after four years of training and experience.

The first trained nurses in the Navy were a group of women employed at the Naval Hospital, Norfolk, Va., in 1898, to care for the sick and wounded of the Spanish-American War. These nurses were neither enrolled nor enlisted and were not sure of being paid for

their services. A verbal agreement was made that they should be reimbursed for their traveling expenses and receive moderate pay if the means could be found for this reimbursement. Later, they were reimbursed from a fund not appropriated by Congress. They served for a period of 50 days.

The Army Nurse Corps was established by act of Congress on February 2, 1901, and, in a short time, demonstrated that the service of trained nurses was a step forward in the care of the sick of the Army. Early reports from the Surgeon General show that their work was of inestimable value.

The Bureau of Medicine and Surgery of the Navy then began its long struggle for a similar corps of women for the Navy. In 1902 a bill was introduced in the Senate providing for the establishment or organization of the Navy Nurse Corps. This bill, although somewhat similar to the bill which finally passed Congress, had one or two interesting clauses that were different. The range of age was from 26 to 40 years, and nurses were to be relieved from active duty after 15 years of continuous service, or sooner if incapacited from any cause originating in the line of duty. Those relieved from active duty were to constitute the reserve of the Nurse Corps and would receive pay not to exceed 50 per cent of the amount received by them when on active duty. The bill also provided that the nurses receive the same mileage as provided by law for officers while traveling under orders in the United States. The initial pay period recommended was $50 a month. This bill did not pass Congress.

In 1904 another attempt was made to get a bill through for the establishment of the Nurse Corps. This bill recommended pay of $40 a month for the initial pay period but made no provision for disability in line of duty or retirement. This bill was not passed either. For several years the Surgeon General, in his annual report, had urged the enactment of legislation to create a corps of trained women nurses. In the report for the year 1907 he stated, in part:

> Intimately related to the proposed reorganization of the Hospital Corps of the Navy, with greater efficiency as the objective, is the question of the employment of women nurses as a part of the medical department of the United States Navy, eligible for service at naval hospitals, on board hospital ships, and for such special duty as the Surgeon General of the Navy may deem necessary. * * * That women nurses are by natural endowment and special aptitude superior to male nurses for much of the duty required in the care of the sick and injured men is generally admitted; that their employment is compatible and would not conflict with the conditions arising from the military character of our institutions may be inferred from the experience of the Army, which acknowledges their work as deserving of the warmest praise; and we have only to look back upon their record of splendid service in modern wars to be convinced of their adaptability to service conditions and of their efficiency in institutions under military control. * * * In our hospitals where the

more difficult, lingering, and dangerous cases are treated it has been found under existing circumstances, impossible to give all invalids the scientific and careful nursing which their particular illness needs, and women nurses would solve the problem and put it in our power to meet these obligations in a manner befitting the responsibility and the time. Moreover, in addition to supplying more efficient medical and surgical nursing than is now obtainable, valuable services could be rendered by the trained women nurses in teaching the men of the hospital corps their special duties in caring for the sick, so that when they come to serve on board ship or at distant stations they will be prepared, with greater surety, to render services in accord with the best usages. * * *

It is impossible to find adequate reason for the difficulty experienced in obtaining favorable congressional consideration of such a meritorious measure of relief. Economy itself dictates this provision. The desirability of trained women nurses in the medical branch of the naval service has for five years been urged upon the department, and, with its permission, upon Congress. The bureau's representation of this measure, the importance of which it urges, has been persistent and forceful, and it has been explained how the lack of proper nursing means greater suffering. The officers and the enlisted men enter the Navy with the assurance that they will be taken care of when disabled by disease or wound or injury. The Government supplies physicians and surgeons, splendidly equipped hospitals, and complete emergency facilities on every ship. The most serious omission in this excellent establishment is the want of that skilled nursing which civil institutions enjoy.

In 1908, the Secretary of the Navy, in his recommendation to the Committee on Naval Affairs called attention to the great need for nurses and embodied in his report the statements of the Surgeon General. A bill was introduced which was very brief and to the point, asking for the establishment of the Nurse Corps, but section 3 read as follows: "That the superintendent, chief nurses, and nurses shall receive the same pay, allowances, emoluments, and privileges as are now or may hereafter be provided by or in pursuance of law for the Nurse Corps (female) of the Army." This bill passed Congress and became a law on May 13, 1908.

As soon as the nursing public learned that the bill had passed there were many applications for appointment to the Nurse Corps and several applied for the position of superintendent of nurses. At that time the candidates were required to take an oral and a written professional examination as well as a physical. These examinations were conducted in Washington, so it was necessary for the nurses to travel at their own expense to Washington and bear their living expenses during the period of time required for the examination, which lasted for about three days. They then returned to their homes, if necessary, to await appointment. Naturally, at this time, the applicants were mostly from the east coast, as those from farther away could not bear this initial expense.

The nucleus of the Navy Nurse Corps, established in 1908, was a superintendent, a chief nurse, and 19 nurses. The chief nurse and the nurses were assigned to duty at the Naval Hospital, Washington,

D. C. There were no quarters for them, but they were given an allowance for quarters and subsistence. They rented a house and ran their own mess. These pioneers were no more welcome to most of the personnel of the Navy than women usually are when invading what man calls his domain. The welfare of the patients was the one object in having nurses, and the patients, as a rule, were most grateful to see them. Paradoxical as it may sound, men are men when strong and healthy, but when sick they are not men but patients. As few were immune to sickness or injury, the number of patients who reverted to type and became men again carried quite a different feeling for women—that is, nurses in the Navy. The knockers became the boosters and Father Time did the rest. It sounds untrue, but some of the older medical men in the Navy were the strongest opponents of the Nurse Corps. Most of these doctors had not worked with nurses in civilian life and some of them had gone into the medical work of the Navy to get away from women patients and, incidentally, their nurses. They disliked petticoat government in the wards of the naval hospitals very much.

Some of the older doctors do not like to admit that nurses have been of any special benefit in the Navy, and one of them is recalled as having said that if he were ill and needed care he would prefer a Hospital Corps man to a nurse. When he is a commanding officer of a hospital, as he has been for many years now, he not only wants nurses, but more nurses, and frankly admits that he can not run his hospital acceptably without them. Evidently he considers them a necessary evil that must be used to advantage.

In 1909 the corps was doubled in number and the promotion of three chief nurses was authorized. It was found that nurses were reluctant to assume the expense incident to appearing in Washington for the required examinations, so the Surgeon General directed that the applicants submit an original essay on nursing subjects in lieu of the written examinations.

Early in 1909 nurses were sent to the naval hospitals at Annapolis and New York. There are many amusing incidents connected with the early days of nurses in the Navy. In the spring of 1909 the commanding officer of the naval hospital at Norfolk requested nurses. When women nurses arrived he was very much surprised, as he had had in mind Hospital Corps men and had no idea that any others would be sent. No provision had been made for them and he was at a loss as to the best method of handling them. So it was with most of the commanding officers. The nurses themselves soon took command of the situation and demonstrated that they could easily fit in and would be a help rather than a hindrance. A little later one Surgeon General, in speaking of the nurses, stated, "They have

endeavored to cling always to the high principles which have made their profession a blessing to humanity and they have tried to demonstrate by their ability and helpfulness the necessity for their existence. They have tried to lift the burden of a particular situation rather than increase the burden by personal demands and requirements."

The nurses have continued to prove their reason for existence in the Navy, not only in the care of the patients but in many other ways. After they became firmly established and more generally accepted, their field of work broadened. The question of the health of our wards in the outlying possessions of the United States had been an interesting one, and arrangements were completed for Navy nurses to take an active part in this work. Training schools for native women have been established in Guam, Samoa, and the Virgin Islands, and the Navy nurses, under the direction of a naval medical officer, have conducted these schools. Education in health and hygiene has been the primary object, and the information imparted and knowledge gained have been disseminated throughout the islands by means of the native hospitals and training schools and the value has been inestimable.

With the Navy nurses the teaching and training of the Hospital Corps men has been one of their chief interests. Not only at the Hospital Corps training schools are there nurse instructors, but a qualified instructor is available at all hospitals, and the training of these men has become an outstanding achievement.

As it is necessary for the medical profession to keep in touch with modern methods in the treatment of patients, the medical officers of the Navy are given an opportunity to take up special courses of instruction at various civilian institutions and at the Naval Medical School, with the result that the patients have the benefit of the latest approved methods of treatment and nursing care. The Surgeon General is very anxious, also, that the Navy nurses shall have every opportunity possible to keep in touch with the work of the nursing profession in the outside world. Through his interest it has been made possible for the nurses who so desire to have special courses in such subjects as dietetics, laboratory technique, anesthesia, physiotherapy, and instructing. The nurses are encouraged to attend nursing conventions whenever possible, and though the law forbids reimbursement of any expense in connection therewith, actual time consumed is allowed in a duty status.

From the establishment of the corps in 1908, many attempts have been made to have legislation passed that would be of advantage to the nurses. In some cases this has been successful, notably, the pay bill of 1922 and the retirement bill of 1926. There is still some legis-

lation for the nurses which the Bureau of Medicine and Surgery would like to see enacted. An increase in pay for the first pay period and retirement for disability in line of duty are two very important items under consideration. When it is considered that it requires much time and labor to get any bill through the intricate and devious paths of Congress, there is reason for congratulation that the youngest corps in the Navy has made so much progress in the short period of its existence. With the earnest cooperation of each and every member, the high standards set by the pioneers in the Navy Nurse Corps will continue and the spirit of service will ever be present.

# NOTES AND COMMENTS

## AN OLD DIARY

Records kept by medical officers of the old Navy are valuable from a historical viewpoint, but sometimes even more so for the information they contain.

Among the interesting papers filed in the Navy Department Library, Washington, is one by Benjamin G. Harris, who was surgeon's mate on the U. S. frigate *Philadelphia* during the year 1800, in which he makes note of some of the incidents which occurred on that ship during the year in which he served on board, states his views as to medical ideas of his times, discusses the influence of climate, and expresses some novel ideas as to the treatment of venereal diseases. In the same paper he records some of the medical experiences which came to him while he was serving as assistant to a surgeon on the island of Montserrat in the Leeward group of the West Indies. These are interesting because they show the type of work done in the years 1801–1803 in out-of-the-way places and with limited equipment.

The paper is reproduced in full below, but no attempt has been made to follow the capitalization of the writer. His punctuation and spelling, which may seem unusual, have been followed.

The keeping of diaries by medical officers should be more common than it is in these days. Events which at the time seem trivial, may later assume a real importance. At any rate, diaries, if kept, will eventually become old and be interesting to future generations for this, if for no other reason.

The diary of Surgeon's Mate Harris follows:

### SOME OBSERVATIONS TAKEN ON BOARD OF THE U. S. FRIGATE "PHILADELPHIA" DURING HER CRUISE IN THE YEAR 1800 AND AFTER LEAVING HER

By Benjamin G. Harris, Surgeon's Mate

*1800*

The frigate *Philadelphia* is a vessel of about thirteen hundred tons, carrying 44 guns and 400 men. Her keel was laid in the autumn of 1798 and she was ready for the sea in April, 1800. She was built with well seasoned timber and by able workmen. Her men were all shipped in good health excepting about 30 who caught the venereal disease after they had shipped or who had it slightly

when they shipped. This disease however being recent among a large majority of that number soon yielded to the power of mercury.

The provisions of the ship was taken on board in the month of March. It consisted of good New England beef and pork; beans, potatoes, rice, butter, cheese, flour of wheat and fish: all equal if not superior to any provisions in the American Navy.

The water of the ship was taken out of the dock at Phila. in March and remained very cool during the whole passage to St. Kitts, so cool as to be painful to the fingers when immersed in it, and in which the thermometer of Fahrenheit stood at 45 in all April. This water being very turbid when taken on board deposited a large quantity of filthy sediment, when that operation was over it was perfectly agreeable to the taste.

The spirit served out to the ships crew was from Jamaica and tolerably good, but few of the officers drank it, having laid in brandy in their own stores.

The vessels used in cookery were iron, tin or wooden (I mean for the crew) and were kept well cleaned. The boilers were made of cast iron entirely except the cock, for drawing off the soup, which was of brass.

I should have observed with respect to the ship's water, that in each large cask when filled there was added about the quarter of a pound of lime, but for what purpose I know not.

*April 5.*—In this condition the frigate *Philadelphia* on the 5th day of April unmoored in order to drop down to Newcastle to take a few more guns and provisions before proceeding to sea; but could get no farther than Miflin Fort.

On the 22nd day of March I made the first observation on board of our ship with Fahrenheit thermometer. In the cockpit which was my berth, the thermometer stood at 50 (at) 9 o'clock in the morning and on the gun deck at 45 and continued daily at that till the end of March. About the time that we dropped down to Mud Fort from April 1, the thermometer stood at 60 upon the gun deck generally and 2 or 3 degrees higher in the cockpit where was a windsail and a ventilator; but several tapers constantly burning there, besides several persons breathing there contributed to increase the temperature of that small place.

We are now at Mud Fort or Miflin Fort, and a great number of our crew are afflicted with a vomiting and purging, exactly similar though not quite so violent as the genuine cholera morbus. There has lately been much wind, and the river water has become very turbid, in consequence thereof. To this I attribute the change in the health of our crew; and I am told that the water always proves a laxative to persons unaccustomed to drink it. I am the more inclined to this opinion, as no possible exception can be made to the provisions, etc., of the ship.

There has been a number of venereal cases under my care since entering the ship, most of which are constantly attended with a discharge from the urethra of a true gonorrheal nature. This conforms with the opinion I have ever held; that the lues venerea and gonorrhœa are not the same, but that the former may produce the latter, but the latter does never degenerate into the lues venerea unless the contagion of lues be applied.

*April 9.*—Left Miflin Fort this day. During our stay here the thermometer stood generally from 60 to 65 and our crew much distressed with the vomiting and purging above mentioned. In attempting to cross the bar below the fort our ship got fast aground. All hands were immediately employed in unloading her of her guns and provisions. It was in this plain that our ship's crew was extremely distressed with this mild cholera morbus (tho' in some cases

very severe) which is no doubt caused, or at least aggravated by the turbid river water, rendered so by the windy weather which we have lately experienced and do now. The temperature of the weather has been very moderate and pleasant, tho' windy.

In some cases the complaint takes on the form of genuine cholera morbus, in others that of dysentery and often that of bilious diarrhea, and in some cases attended with fever. The diagnostics were an excessive thirst very constant, and prostration of strength, more or less according to the violence of the symptoms. The ship as yet supplied with fresh provisions from Phila. I have said that in several cases this disease was severe; it was particularly so in one case. It was that of Joseph Richardson, a midshipman on board, about 30 years of age. In this case there was a genuine cholera morbus, with great prostration of strength and excessive thirst. It terminated in an inflammation of the bowels, followed by a diabetes, and it was the last of April before he recovered his health.

*April 11.*—At high water this day our ship was afloat, after being evacuated of all her great guns, shot, provisions and wood.

The cholera (the now prevailing complaint) has nearly traversed the whole ship's crew, officers not excepted. When assistance is given timely, it is generally easily cured by evacuants, succeeded by astringents with opium, but astringents alone have never answered as a remedy.

The river water has become clear, but notwithstanding the disease still prevails.

*April 17.*—Set sail from our anchoring ground below the fort and again our keel touched the bottom on a small shoal opposite Chester, but were afloat again the first flood tide.

I am informed by an old seaman that it is the custom in some island (I forget where) to bury scorbutic patients up to the neck in fresh dug earth every day; and with very great success.

*April 19.*—Yesterday we dropped anchor at Marcus Hook. To-day the cholera appears to diminish amongst the crew, tho' relapses from exposure to cold, as night watching, are very frequent. The weather at present is very mild with southerly breezes.

*April 24.*—Left Newcastle at 6 a. m. and anchored off Bombay Hook where we remained only two days and then proceeded to sea.

*April 27.*—Lost sight of the lighthouse at Cape Henlopen this day at 11 a. m. We have been now three days drinking the ship's water. There is very little of the cholera at present among us. I am told that this complaint is very common to persons unused to drinking the river water, but it is never so violent as our crew have been.

*April 25.*—Many of our crew complain of excoriation of the membrane of the mouth. I believe it is customary for bakers to put a considerable quantity of potash in the bread before baking it. Whether this causes these excoriations, or whether it is caused by the lime which was mixed with the water when filling I know not, but I am rather inclined to subscribe to the latter opinion.

I am informed by a gentleman of credit that he has been completely cured of a gonorrhea by taking mercury internally; and without any injections or external applications. This is contrary to what I have ever believed on the subject, although it is firmly supported by the followers of John Hunter.

*May 10.*—The thermometer since 1st inst. has stood in the cockpit from 75 to 80 and on the gun deck from 70 to 75. Our crew are getting more healthy; but wounds and other accidents are very frequent yet, owing I suppose to a great part of the crew being inexperienced on board of ship. On the 1st day of this

month two of the sailors got very much injured thro' negligence or inexperience. The one while ramming home a cartridge in one of the great guns, had his arm unfortunately shot away; an amputation was immediately necessary; which was performed above the cubit by Surgeon Champneys. In one minute after this another sailor, by the bursting of a powder horn had both his hands much lacerated with the loss of one of his little fingers close to the metacarpal bone. These however both recovered in about 6 weeks from the accident. At 6 p. m. this evening Reuben Harford had the misfortune to fall from the main top upon the quarter deck. He fractured his right humerus and received a violent concussion of the brain, succeeded by hemorrhage from the right ear and a great derangement of the sensorial faculty.

*May 23.*—I have ever held it as an opinion that venereal chancres always make their first appearance upon, what are called, absorbing surfaces, such as the lips, glans penis, etc., but I have seen several cases on board of this ship that tend to an opposite opinion. Frequent applications have been made to the surgeons for the care of ulcers on the body of the penis quite unconnected with, or rather at a distance from, the glans penis or the frenum, which appear at first to arrive entirely from filthiness and negligence in keeping the parts clean; but appearances are too often deceitful. These cases were too frequently obstinate and would yield to no applications, nor internal medicines except a regular course of mercury, which never failed to produce a speedy cure of the ulcers.

*May 25.*—Arrived this day at the Island of St. Kitts and anchored in Bassatue Roads, I had previously thought of wearing flannel next to my skin during the whole cruise in these West Indies but found it extremely disagreeable thus far and took it off. Although the climate here is no hotter than that of our own, in summer, yet the vicissitudes are much more frequent and indisposition often follows on that account. But the wearing of flannel, altho' it might probably ward off the impending blow from that cause, yet the consequence of wearing it would in my opinion be as disagreeable. I mean debility. The heat of the weather in these climates being equally as great as any in the world, which (heat), being one of the most powerful stimulants, and aided in its effect by the stimulus caused by the minute and numerous points in the flannel upon the skin, produces an increasing and superabundant discharge of perspirable matter.

*May 27.*—Set sail in company with the Adams frigate on a cruise before Guadaloupe. Our crew being in a very good state of health.

*June 11.*—One of our officers I. M. discharged about 4 foot of a tapeworm, with which he had for some time been afflicted. The evacuation of the worm was produced by taking some of a quack medicine called Hamilton's lozenges; which I suppose to be nothing but calomel made up with some kind of farinaceous substance and scented in order to enhance the value of it. I. M. has a florid complexion, good appetite and digestion, and every appearance of unimpaired health. He has discharged some portion of the T. worm before, by the same medicine, but could not effect the removal of the whole animal.

Genuine venereal chancres are such as occur on the glans penis, lips, etc., on what are called absorbing surfaces and that are succeeded by buboes. But what are those ulcers called that are found on the body of the penis at a distance from the glans, and that will not admit of being cured, except by mercury, and that cause inguinal buboes? Cannot they be termed chancre also? I have seen several instances of these kinds of ulcers among the crew of the *Philadelphia*.

*June 20.*—Historians say that the atmosphere in this country abounds with an acid (I suppose the nitrous acid) which speedily causes metals to melt. But this effect upon metal is well known not to be peculiar to the West Indies alone. My watch has become tarnished and steel buttons rusty in the Chesapeake Bay in the United States; and persons of respectability have informed me that the same thing occurs in European voyages.

*July 20.*—Herpetic eruptions are now very rife among our crew. A subsistence of three months only upon salted provisions has evidently had the effect of producing this disease. One of the landsmen I. P. resided on shore about two weeks on fresh provisions, and by that means was freed from the disease; but a return on board of ship, (consequently a return to salt meat) reproduced the herpetic eruption.

The cashew nut, which grows here, is an infallible remedy for any kind of herpes. It produces a considerable inflammation of its own, when rubbed on the part affected, but after two or three days the inflammation subsides and a desquamation of the cuticle takes place; leaving the parts tender but sound and healthy. I have given the corrosive sublimate a fair trial upon myself, but a cure was not effected.

*July 30.*—Historians have widely erred, in my opinion, in their description of the climate of the West Indies. It has been represented by many, that the air is much colder in the night here than it is in the United States in the summer, so as to require a much greater quantity of clothing. A residence of a considerable time in these Windward Islands convinces one that the heat of the weather is not greater here than in the United States, neither is the difference greater, between the air of the day and night than it is in the United States, I mean in the summer season.

I am informed by a captain of a merchant ship that he has cured himself of a gonorrhea virulenta by taking twenty drops of Thulington's balsam twice a day. Would not balsam copivi and most of the other balsams operate in the same manner being all diuretics and curing the disease (I suppose) by that means.

*Aug. 15.*—Perhaps exercise operates more against producing corpulence in swine than in any other animals. I have frequently observed a small dog, playing with a particular pig on board. The dog increased apace both in stature and corpulence while the pig was daily decreasing, altho' it had an excellent appetite and appeared well in every respect. There were many other pigs of the same age on board, that grew and fattened very fast. Hogs are, I believe, the most indolent animals on earth excepting the sloth, and it is probable that a state of indolence induced in any animal might be followed by an increase in corpulence and probably in stature.

During the last three months bilious remittents have been very rife on board of us; the dysentery also has been troublesome. Almost every case of the above complaints have been attended with local determination to the lungs, with considerable cough and pain in the breast that in many cases required several bleedings.

*Sept. 1.*—Are not persons, afflicted with scurvy, sooner salivated than persons in health? It is hinted at, by some authors, and not without great probability. Several scorbutic patients now on board whose mouths indicated a great tendency to scurvy, having had occasion to take common mercurial purges (of jalap and calomel) which operated very well, by the bowels, in every case, yet they become completely salivated. Considerable swelling of the parotid, submaxillary and sub-lingual glands, with a great increase of thin secretions; tumid and spongy gums, frequent hemorrhages from them, and many ulcers in them and on the tongue.

In scurvy the mouth gums and salivary glands are, I suppose, in a state of preternatural excitability consequently sialagogue medicines are more certain of their operation, and that even if administered in very small quantities.

*Sept. 4.*—At 9 o'clock p. m. I saw, for the first time, a nocturnal rainbow; caused by the moon's rays falling upon drops of rain. It showed no variety of colour, similar to that caused by the sun, but was of the same form and exhibited a white appearance.

This morning the moon was full; the wind is extremely variable, the sea rolls in mountainous swells, and the sky is clear. These are said to be precursors of hurricanes, so dreadful and destructive to the world, of both nature and of art. Lat. 17° 56′.

*Sept. 5.*—The weather turned out squally last night, and our fear of a hurricane subsided at the commencement of a steady breeze and smooth sea, this morning.

The following method of preserving lime juice is practiced, and strongly recommended by Capt. Stephen Decatur:

"Take any quantity of the acid and boil it in an earthen vessel till one-fourth is evaporated, taking care to scum it with a wooden ladle as long as any appears on the surface of the acid. After one-fourth is evaporated, it must be removed from the fire and strained through a flannel cloth. One-half pint of brandy is to be added to every gallon of the acid thus prepared, which is then to be sealed up in bottles for use."

The captain asserts from experience, that this method of preparing the acid renders it capable of being preserved several years without being unfit for use or at all impaired.

The addition of the oil of olives, would no doubt more effectually exclude the air and certainly the more the acid is concentrated, the better it is preserved and the more convenient for travellers.

*Sept. 12.*—Philosophers affirm that water can not be supported in a tube open at the lower end, higher than thirty-two feet from the surface of the earth. I made an experiment on the 12th September, to windward of Guadaloupe, which destroyed this opinion in my mind, altogether. I took a glass tube about a foot in length, and filled it with water. I then sealed it at one end and sent it up, by means of the signal halliards to the foretop gallant royal mast head. It remained there a few minutes and then it was hauled down, but not a drop of the water had escaped, altho one end was open.

The thermometer generally stands at 83 in the morning and evening, and 85 or 86 at noon upon the gun deck in a cool place.

*Sept. 13.*—At one o'clock p. m. the thermometer stood at 86 on the gun deck it being a clear day. I then exposed it to the rays of the sun (but not in the wind) for one hour; the mercury arose to only 120 degrees.

*Sept. 15.*—The mercury standing at 85 as usual, at 2 p. m. I exposed the thermometer to the sun beams for one hour, the mercury arose to 125 in a calm place. I then covered the bulb with black cloth and in one hour's time the mercury was up to 150, tho the degrees could scarcely be seen on account of large drops of water having settled on the inside of the glass case owing I suppose to the increase of evaporation.

*Sept. 18.*—I am informed that the cinders of tobacco is very good in the cure of venereal chancres—when sprinkled upon them. The information obtained from an Italian seaman on board who informed me that it was a very common application to chancres and a very successful one among his countrymen.

*Sept. 25.*—The number of sick on the surgeon's list is nearly thirty this day and the whole of them are pulmonary complaints or the scurvy, or both con-

joined. The pulmonary complaints are remarkably obstinate, and require copious bleedings and other evacuations.

It is more than probable that this is the most unhealthy season in this West Indian climate. I mean the hurricane months.

*Oct. 15.*—A disease very similar to the influenza, is very prevalent on board of our ship at present. The weather has not been remarkably bad; neither has any other circumstance occurred that might render a common cold so rife. This renders it more probable that the disease is contagious. It commences with sneezing; a slight inflammation of the top of the trachea, succeeded by a cough; and a stoppage of respiration thro' the nostrils, with a coryza and headache.

*Oct. 17.*—Yesterday and to-day has been remarkably stormy weather; attended with much rain, which has evidently increased the influenza. The moon will change to-morrow. The thermometer stands generally at eighty-four in a pleasant place on the gun deck, tho' the surface of the body for several weeks past has sensibly perceived a lesser degree of heat; or a cooler temperature of weather.

*Oct. 25.*—At present there are about twenty patients on the surgeon's list and three-fourths of them are terminations, or rather aggravations of the disease above mentioned (the influenza). The coughs are in many cases violent, attended with considerable diarrhœa and pain in the frontal sinusses, and to this is joined, five times out of ten a troublesome tenesmus with an aggravating thirst. This attendant diarrhea we suffer to continue in moderation but it does not afford that relief from the troublesome cough which we have a right to expect according to the general operations of nature. As the pulse is in almost every instance very frequent, small and weak, tho' sometimes tense, it is seldom in our power to afford relief by bloodletting. Our most successful medicines have been, cathartics in the beginning; mild laxatives and antimonials afterwards, with blisters, succeeded by cooling nitrous draughts, squills and opiates.

*Nov. 1.*—Since going into St. Pierres (Martinico) our crew have been quite free from the scurvy, and all except one man who is yet ill speedily recovered who were then affected with that complaint; altho' our stay there was so short a time as four days; our arrival there being on the twenty-seventh of September last and our departure on the first of October.

The speedy recovery of those scorbutic patients is more astonishing, because they were not allowed fresh provisions but one day, if we except what little they could purchase themselves, from the negroes, which indeed was inconsiderable.

The wind has been extremely variable for several days past, blowing however from westward, commonly. About four days ago we were as far north as lat. 20° 2′ and the thermometer stood at 82 the greatest part of the twenty-four hours. This however has been the standard for four weeks last past. But to our senses the temperature of the weather has been or has appeared to be much lower.

During the months of August and September last (i. e.) the hurricane months, the weather has been and perhaps has been the case every year uncommonly squally and variable, frequent calm; sometimes an obscure and clouded atmosphere; at other times it is a clear and transparent, frequent and heavy swells of the sea and extremely variable winds.

*Nov. 5.*—Last night at 7 o'clock died James Wilson, a soldier with the scurvy combined with an affection of the lungs. He was the only person on board that did not recover from this disease after we went into Martinico.

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*Nov. 6.*—At 10 o'clock last night died Stephen Bond, a landsman with a dysentery, combined with a pulmonary inflammation. He expired under a hemorrhage of red blood from the rectum and a considerable irritation of the lungs with a very troublesome cough.

*Nov. 12.*—This morning at 4 a. m. died James Artfield, of a violent remittent bilious fever attended through its whole course, with considerable derangement of the sensorium commune.

*Nov. 26.*—At 4 o'clock this evening died William Griffits (the sailmaker's mate) of the scurvy, attended with considerable fever and cough.

*Dec. 3.*—John Graham (landsman), a black man has had a violent attack of pneumonia, is now a convalescent. He was bled five times (amounting to about fifty-six ounces). Took one Mercl. Bolus of about twelve grains of calomel. The common powder of nitre and emetic tartar freely and drank three pounds of the Seneka tea, during the continuance of the disease. His mouth is now swelled and inflamed, teeth loose, salivary glands considerably affected and has every other symptom of a complete salivation. On the first day of the disease he took the Mercl. Bolus, and on the fourteenth his mouth became sore. Does not this corroborate the assertion of the celebrated Doctor Barton of Philadelphia, "That the Radix Seneka salivates when taken freely, as soon and as freely as mercury."

The thermometer, standing in its usual place on the gun deck. The mercury descended no lower than seventy-nine, the whole of last month. The surgeon's sick list has amounted to thirty in number each day. The month of November is said to be the most unhealthy in the year in these West Indies.

*Dec. 10.*—This day by permission of the captain and surgeon I left the frigate *Philadelphia* to live in M. Serrat as assistant to Doctr. John Carey at the rate of £250 per annum and board.

*Dec. 15.*—This day I agreed to reside assistant to Dr. Carey at the rate of £250 per annum and board at his table. Commenced duty.

Same day occurred a case of wounded head. William Haynes sailor in the Monfort (?) privateer was shot thro' the head yesterday morning in an action with a French privateer. The ball entered just about the center of the forehead, thro the frontis and passed out just behind the right meatus auditorius externus. We dressed the wound, bled him, gave him salts to open his bowels, and afterwards nitre and the bark. He took nourishment and diluting drinks, was sensible at intervals. The discharge from the wounds was very great and offensive. It came as well from both ears and his right eye as from the orifices made by the shot. The discharge was sometimes portions of the brain alone, and sometimes ichorous thin matter. His pulse was full and slow and his skin hot for the first week, afterwards it became weak and frequent. He died Dec. 26th the 14th day after the accident. A large quantity of water ran out from the cavity of the skull just before he died. His urine was discharged constantly of a saffron color and in large quantities. No fungus excrescences made their appearance from the brain.

*Dec 25.*—This day three severe shocks of earthquakes were felt here. The first happened at ½ past 11 o'clock a. m. The second at ½ past 3 p. m. and the third at ten minutes past 7 p. m. The weather was rainy and squally yesterday and the day before.

*Dec. 26–27.*—These two days it has been remarkably windy and cloudy with some rain and then cool. On the 25th it was cloudy and in the evening there were several showers of rain.

The year 1800 ends with rainy and windy weather at the same time the temperature cool and pleasant. The thermometer standing generally at between 74 and 82 in a cool and moderate situation.

Gonorrhea virulenta I find so much easier and sooner removed by means of mecurial alteratives than by injection.

Ends the year 1800.

*1801*

*Jan. 2.*—An express arrived this day from St. Kitts to the President making known that an attack was intended upon the island by the French of Guadaloupe. The military and militia were immediately put and kept under arms day and night till farther accounts. Dispatches were sent to Antigua, St. Kitts, and Martinico for troops but none came except 50 from Martinico.

*Jan. 21.*—The militia excused from duty more than once a week.

This day I sowed some seed of the Papaver somnifera and two seed of the American plumb. The mercury in Fahrenheit thermometer stood at 142 in the sun. Only 82 in the shade. The day being perfectly calm and free from clouds.

*Feb. 2.*—I was present and assisted this day in performing the operation of trepanning. The patient received a blow from one of the wings of the windmill, three days ago; was immediately seized with vomiting but no other symptom of concussion or compression of the brain at that time. He was bled and took nitrous powders. He remained well until about noon yesterday, when he was affected with stupor, a slow and intermitting pulse and with a considerable dilation of the pupils of the eye, Upon a second examination of the head no determined spot could be fixed upon for making a perforation, not the least external injury could be seen yet it was evident that the brain was compressed, and that the operation gave the only chance of preserving the patient's life. By laying the cranium bare along the parietal bone and squamous suture a fissure was discovered very near the suture. The trephine was applied and a considerable quantity of serum and blood was discharged from between the meninges of the brain which gave the patient some relief. The wound was dressed S. A. but the symptoms of oppression increasing, the patient died about ten hours after the operation perfectly comatose.

Upon dissection it appeared that there was a considerable extent of fracture of the occipital bone and the mastoid process of the temporal and extravasations of blood in several places.

I recollect of seeing a man (whose name I forget) on board U. S. frigate *Philadelphia*, who was visited at every lunar revolution, with an eruption of red blood from his navel. This man was healthy in general but was very tall and slender.

*Feb. 21.*—This day "Doc" Carey and myself performed the operation of amputation of the femur upon a patient the property of J. R. Frye. A sphacelation of the whole foot and part of the leg had taken place. The cause was a fracture of the leg very low down from a fall and which was concealed for 6 days after the injury when mortification had taken place.

Doctor Carey and myself trepanned a little negro of Mr. Musgraves, aged about 3 years. She fell from a flight of steps down upon the stone pavement, a distance of about six feet and fractured the os frontis just above the orbit of the right eye. Convulsions immediately ensued which did not leave her until the pressure of the extravasated blood was removed from the brain. She was vomited and put into the warm bath but without effect, the nervous system remained in a deranged state until the trephine was applied. The antiphlogistic regimen was strictly adhered to and purging and sudorific medicines frequently administered to prevent and remove stupor and fever which sometimes came on. The cicatrix was perfect in three months from the day of the operation.

*October 1801.*—Assisted in dissecting James Irish supposed to have been poisoned. The stomach and intestines appeared to have had considerable degree

of inflammation. The concave surface of the liver was of a leaden color, the convex surface was natural. The gall bladder small and nearly empty. The mesenteric vessels very turgid with red blood. There was an effusion of about two pounds of pure serum in the cavity of the abdomen. The urinary bladder was searched for a considerable while before it was found. It was much contracted and without a drop of urine. This led to an examination of the kidneys. They were taken out and found to be of an enormous size, weighing at least sixteen ounces each. No calculi however were seen upon dissecting them. The ureters were in a natural state. The pelvis of kidneys no way distended.

This patient was affected with fever [1] of the common bilious type, but accompanied with no local pains in the loins; he was upon the recovery when he left town to remove into the country for a few days. He was seized with despondency and nervous debility, accompanied with considerable serous effusion into the cellular membranes.

A mulatto woman, the property of M. N. B. Daly died of a genuine typhus gravior. Several days before death she was in a complete ptyalism tho' no sialagogue medicines of the mercurial kind were administered. Does this often occur in the low states of nervous fevers?

*December 1801.*—Two men were preparing to blow up a rock. The powder accidentally took fire before they were aware. The explosion was very great and wounded both severely. The arm of one was so much torn as to render amputation necessary. The other had one arm blown away, the other arm badly wounded and his face almost torn to pieces, but what appeared to be the most dangerous wound was in the abdomen. The first joint of one of the fingers was forced into the abdomen in contact with the intestines, it however was extracted, and soon healed. The other wounds soon put on a favorable appearance and healed also.

*April 10th.*—A negro boy of Nicholas Hills received a kick from one of the mules, just above the orbit of the right eye which penetrated through the os frontis. He was trepanned for it and did very well. No symptoms whatever came on indicative of compression of the brain either before or after the operation. Without doubt the injury extended no further than the frontal sinus. The wound healed without exfoliation.

*May 21st.*—A man, the property of James Willock, in the year 1800, received a blow upon the occiput. Not many days after an abscess was formed in the integuments of a considerable size, it was opened and pure pus was discharged in a large quantity. The incision healed all to a very small point which continued open, and through which matter constantly flowed. When the discharge was not copious the patient was in great pain and vice versa. In this situation he remained until the above date when upon examination it was found that the probe passed through the integuments and occipital bone down to the dura mater. The operation of trepanning was advised as the only chance of affording relief. The patient consented and it was performed, and a large quantity of matter immediately discharged. The piece of bone taken out was three-fourths of an inch thick, the cure went on well.

*1802*

*Jan. 8.*—Extracted the placenta from a woman called Joan, the property of Frdk. Meade Esq. The os internum being very much contracted on account of the foetus having been delivered at least twelve hours before. It was stillborn. No fever of consequence came on afterwards.

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[1] His cure was attempted by mercurials, largely administered both by the mouth and by inunction.

During the months of December, January, February, March and April last, the winds have been almost constantly from the northward and the weather consequently cool. Since the beginning of April but not before, pleurisies have been extremely rife, (among the negroes especially) and so inflammatory that two or three bleedings were always necessary to reduce the pulse sufficiently. Children have suffered very much from this inflammatory disposition of the atmosphere; from the relaxed and debilitated state of their lungs it affects them in the form of tussis convulsiva or whooping cough which remains for a considerable time very obstinate. It is now August, and this cough still remains nearly as violent as in the former months, all persons under fifteen have felt more or less the severity of it upon the lungs, yet few die with it in proportion to the number that fall under its attack. We have tried bleeding, purging, blistering, warm bathing, and have exhausted the whole tribe of expectorants but without effect; are now making use of bark and the cold bath (keeping the bowels very loose) and the change of air. This treatment has proved more beneficial than anything hitherto tried.

The case of a negro driver on the estate of E. Parsons, Esq. In making an exertion a portion of the ileum came down through the abdominal ring. He had been troubled with a rupture of the same side, of course this attack was disregarded for a day or two. It however became very painful on the third day and assistance was called for. The usual endeavor of every kind, both surgical and medical was made use of but without good effect. The abdomen at length became very tumid, no stools for five days. Hickup came on, and cold sweats, extremities cold, and pulse extremely quick and weak. The patient had been previously advised to undergo the operation, and was warned of the inevitable consequences of delay, but was obstinate in his refusal to submit; at length about the close of the fifth day from the descent of the hernia, when the above unfavorable symptoms came on, he agreed to have the operation performed for the bubonocele in order to reduce the intestine. It was done immediately by Doctor Daniels, assisted by myself; the intestine reduced and the lips of the wound brought together were retained by stitches and adhesive plaster, when we left him to rest, soon after which he had copious stool, from which he received great ease. I should have observed that in the hernial sack there was found at least a pint of serum, tinged with blood, and that the portion of intestine down was not larger than a common sized hen's egg. His pulse continued very weak and fluttering for some days after which the wound began to suppurate kindly, appetite became good and he did well.

*1803*

In the months of January, February and March of the present year, the weather was very dry and calm, of course very warm in the day. The thermometer for the most part standing at 88 at noon and until 3 of the clock in the afternoon. In proportion as the day was warm and calm, the exhalations from the sea became more abundant, and consequently the dew at night was more considerable, which refrigerating the system, as it were, rendered it very unfit to receive so suddenly the darting rays of the blazing meridian sun, on the following day. Whether this state of the weather was the cause of several cases (eight or ten) of malignant fever, (most of which proved fatal) or not, it is uncertain: plain it is however, that most of them were attended with considerable derangement of the brain, and all with inflammation of the eyes. Two or three foreigners who had lately arrived, died in the course of 72 hours after the first attack of this fever. The natives who survived were a long time recov-

**ering. Those who died had the disease 12, 14 or 16 days before death closed the scene. Hemorrhage occurred in every case which proved fatal, evidently showing a dissolved state of the blood. Those who died became of a livid or yellow color, immediately before and after death.**

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## AMERICAN COLLEGE OF SURGEONS

The American College of Surgeons each year heretofore has generously invited the Surgeon General to nominate a specified number of medical officers as candidates for fellowship in the college.

Assuming that the privilege will be extended to the Navy again this coming year, it is suggested that officers desiring to have their names considered for nomination submit their applications not later than July 1, 1928.

Although, for officers of the Navy, fellowship is made a matter of courtesy, it nevertheless seems proper that there should be presented as candidates only those officers who are fully qualified for fellowship in accordance with the standards set by the college. Consequently it is the fixed policy of the bureau to stand sponsor for only those officers who, in the opinion of the bureau, meet the high standard of professional qualifications set by the college, and who are prepared to comply with all the professional requirements imposed by the college on candidates from civil life. Should the number of qualified applicants exceed the number of nominees permitted, the order of selection will be according to relative merit.

To be eligible for fellowship without technical examination, the candidate shall be a graduate, of at least seven years' standing, of a medical school approved by the American College of Surgeons.

The candidate shall give evidence that he has served at least one year as interne in an accredited hospital and two years as surgical assistant, or he shall give evidence of apprenticeship of equivalent value. As a means of furnishing precisely the information desired it is requested that the "application for fellowship" (obtainable from the bureau) be filled out and submitted with the applicant's case reports.

Letters also may be submitted by the candidate testifying as to his personal traits as well as to his professional qualifications.

The professional activity of the candidate shall be restricted to the study, diagnosis, and operative work in general surgery or in special fields of surgery, such as eye, ear, nose, and throat, genitourinary, orthopedics, and gynecology and obstetrics.

As evidence of his qualifications in the technique of surgery the candidate is required to submit in complete detail, through official channels, the case records of 50 consecutive major operations which he has performed himself.

In addition to the complete records of 50 consecutive major operations the candidate is asked to submit in brief abstract a report of at lease 50 other major operations in which he has acted as assistant or which he has performed himself.

The senior medical officer with whom the candidate is serving, when forwarding these case records and the abstract of major operations in which the candidate has assisted, shall furnish, by means of an appropriate indorsement, his estimate of the candidate's qualifications for fellowship.

The attention of prospective candidates is invited to the desirability of having case reports typed on paper of cap size, suitably arranged and bound, and prefaced by both an index to cases (Form P), and a summary giving the total number of operations of each type; e. g., appendectomy, 14; cholecystectomy, 2, etc.

It is important further that each case be identifiable by recording (*a*) institution; (*b*) hospital number; (*c*) date; (*d*) initials.

### RESIGNATION AFTER SPECIAL COURSES

In spite of frequent statements from the department to the effect that those officers of the Navy—medical as well as others—who receive the benefits of special courses of instruction are expected, and should expect, to render some adequate return to the Government for the money spent in furthering their education, it is still a not infrequent occurrence for an officer to request the acceptance of his resignation shortly after completing his course. The policy of the department is to refuse such requests and to require such an officer to serve at least three years in the Navy after completion of any special course of instruction. In fact, in accordance with departmental instruction, issued September 21, 1925, all officers requesting postgraduate courses are required to submit with their requests a signed agreement to serve for at least three years after the course is completed.

### MENTAL IRRITABILITY IN THE TROPICS

"Tropical neurasthenia" is the term used to describe a symptom-complex made up of mental irritability and nervous breakdown, which, unfortunately, is of too common occurrence among Europeans and Americans who dwell in the Tropics. Its etiology has been an unsettled question since it was first recognized.

Morden Carthew, M. D., D. P. H., formerly adviser to the department of health, Siam, has thrown new light upon the subject in a paper published in the Journal of Tropical Medicine and Hygiene of May 2, 1927.

Carthew considers the term "tropical neurasthenia" inadequate and suggests that these conditions fall into two groups with distinct characteristics. The first group comprises the ordinary "nervous breakdown," which differs in no way from the same condition as observed in temperate climates and is no more frequent. The second group comprises "* * * a large number of minor psychic disturbances characterized by mental irritability, inability to work at full pressure, and a mild depression which, of themselves, do not qualify such disturbances to be called typical psychoneuroses; but indicate, rather, a neurasthenic condition which is but a preliminary stage of the more advanced condition of nervous breakdown." It is this second group with which this paper deals and which is of such economic importance to the world.

The symptoms of this type of psychic disturbance are a progressive loss of energy, mental and physical, loss of memory, irritability of temper, mild anxiety and depression of spirits, sleeplessness, slight photophobia and anorexia.

Causes which have been assigned to this condition are many, among these being temperature, humidity, winds, ultra-violet rays, electric disturbances of the atmosphere, diet, unsuitable clothing, and close association with the natives. These have been supposed to result in a toxemia or a lowering of body tone which caused the nervous system to become exhausted. As the author says, in no case has a purely psychological cause been suggested. In this paper he attempts to show that the "cause is essentially psychological in character."

The writer does not consider the individual but the herd. Various herds have specific social customs, evolved by the gregarious instinct and environment. These customs have become "a secondary instinctive character" and each race has come to consider its own customs as best and necessary for completeness of life. This has led to antagonism between the races. "The individual of one herd carries with him all his secondary social instincts and their resulting customs." This leads to mental antagonism, as it is necessary for him to suppress or modify many of these in order to live in harmony with his new surroundings, and he has no outlet for his emotions in his strange environment. To quote:

> It is accepted by many modern psychologists that psychic disturbance and neurosis is constituted by a general ensemble of phenomena resulting from the nonadaptation of the individual to any continued emotional cause and from his struggle to bring about such adaptation * * *. It is held, on the other hand, that such psychic disturbances will be inversely proportional to the degree in which the individual can conserve his intellectual control.
>
> The suggestion is therefore now offered that the wanderer from his herd on going to the Tropics is subjected to a mental conflict caused by the antagonism between a call to rejoin his herd in Europe and his instincts of acquisitiveness and curiosity which in the first instance caused him to wander.

It is a mental battle between his own firmly fixed social instincts and those of the indigenous herd. It is a battle between his instincts and his foreign physical environment.

With mental conflict emotion is always created and it is suggested that the conscious emotion shown as the result of this conflict is but the feeling of "home sickness" with which all of us who have lived in the Tropics are so familiar, and which, if unduly repressed, gives rise to all those minor psychic disturbances described under mental irritability and its associated symptoms. * * * Without the primary presence of mental conflict and its resulting emotion there can be no psychic disturbances, and in fact "home sickness" is but exaggerated emotionalism.

According to the writer, the French are the most emotional race in Europe and therefore do not make such successful colonists as the more phlegmatic British.

The Chinese, although they are distinctly gregarious, have a less highly developed social system of their own and, consequently, do not repress their emotions to the same extent as the British and French. For this reason they are better able to adapt themselves to new environment.

History shows that the British, as a race, do not stand the Tropics well and that prolonged tropical residence "that includes an intimate association with the indigenous inhabitant" takes a heavy toll.

The British have always attempted to make their surroundings in the Tropics as nearly like home as possible and to withdraw unto themselves in their hours of relaxation. Alcohol has been found by them to be "a fairly efficient lubricant for mental friction," therefore it is used to a greater extent than at home.

Carthew classifies the European and American dwellers in the Tropics into three types:

(*a*) The adventurer, who forms by far the great majority. He has journeyed to the Tropics in obedience to his secondary instincts of curiosity, hunting for food and the wherewithal to obtain his creature comforts with greater facility than he can at home * * *. He invariably returns to his country of origin for a minimum period of six months, every three or four years, and considers himself hardly used if he can not permanently retire at the age of 50. Almost without exception he begins to experience * * * strain in carrying out his work at the end of his third year after arrival and * * * at the end of his second year after his return from leave * * *. After five years' continuous residence the mental and bodily strain is much more marked * * *. If he prolongs that uninterrupted stay to 10 years he often suffers from an acute nervous breakdown * * *.

(*b*) The missioner. This type is chiefly, though not always, composed of missionaries of various denominations who are possessed by an impelling force to leave their homes and herd for the purpose of teaching their ideals to a tropical herd * * *. As a rule * * * they live a far from luxurious life in much closer contact with the indigenous inhabitant.

The Roman Catholic missionary seldom returns to his herd oftener than once in 10 years * * *. These men are noted for their cheerfulness, equability of temper, and the philosophy with which they adapt themselves to their uncon-

genial surroundings. It is very rare for one of them to exhibit any of the symptoms of a minor psychic disturbance, and the writer has never heard of one suffering from an acute nervous breakdown. European and American missionaries of other denominations, * * * usually take home leave every seven to eight years and the majority remain at their work till the age of 60 or 70 before retiring. As a whole they show far less signs of mental strain and conflict than the adventurer * * *. The superiority of the missioner type over the adventurer in retaining his mental health can be explained psychologically * * * he is imbued with the missioner spirit and hence is willing to undergo a preliminary training in controlling those emotions and canalizing those instincts which are at variance with his social environment * * * With him the unwanted emotion is but a problem to be solved * * *. By bringing all his altruistic social instincts and customs into play he forces his antagonistic instincts into altruistic channels, thereby relieving the pressure of marked mental conflict with the foreign herd and environment. It is suggested that it is for this reason that he suffers from both the minor and major psychoneuroses to a far less extent than wanderers of the adventurer type.

The writer is under the impression that it is along this line of thought that a solution will be found for the prophylaxis and treatment of the minor psychic disturbances of the Tropics.

(*c*) The beachcomber, or "poor white," is a type composed of men with little will power, of weak moral and mental character, usually, though not always, of the lower classes. They are men who are content to spend all their days amongst the lowest type of tropical indigenous inhabitant, adopting with ease all their vices and none of their virtues * * *. Possessing little or no herd instinct his tropical environment is in no way antagonistic to him, there is no mental conflict, no homesickness, and, hence, none of the signs of minor mental disturbance are in evidence.

Prevention being better than cure, as the writer says, why would it not be possible to develop a mental hygiene for life in the Tropics comparable to the physical hygiene which has reached such a high state of efficiency? The prevention of uncontrolled emotion is the aim, as its prevention would prevent the occurrence of the mental disturbance. The person who is going to live in the Tropics should be taught how to divert emotions into useful channels. In other words, he must learn how to sublimate his emotions.

Sublimation may be accomplished through many means. Among the British dwellers in tropical climates sports have long been made use of for this purpose, and with great benefit. As the writer says:

Sport and athletics, however, are not the only effective methods of sublimation nor the only way by which conflicting emotions may be avoided by the wanderer. Sublimation of the instinct of curiosity can give rise to all forms of scientific investigation and research, and has been the origin of all the sciences.

The gregarious instinct can be sublimated by the cultivation of sympathy and charity * * * not only toward his own herd, but also toward the foreign herd with which he associates. It can be sublimated by a greater control over that feeling of superiority which is so much in evidence in the newcomer to the Tropics and its canalization into effective altruistic channels. * * *

There are many other altruistic methods within the reach of every individual taste which can be searched for and applied by every wanderer, but only when he understands the necessity for the search and for their application, and when he recognizes that a successful search will have a tremendous effect on his own comfort and peace of mind.

Carthew suggests that people be divided into three classes, as to their suitability for life in the Tropics. In class A he would place those who are able to canalize their emotions with success. These are fit for service anywhere in the Tropics. In class B he groups those who are only partially able to canalize their emotions with success. These he considers fit for service in the Tropics but with qualifications. Class C is composed of the adventurer type who is unable to canalize his emotions with any success. These are unfit for life in the Tropics and should remain in the environment of their own herd.

By proper selection of those sent to the Tropics the writer believes that much of the racial antagonism which is now so evident may be overcome.

### THE PERSONAL FACTOR IN FLYING ACCIDENTS

Mechanical details of aircraft may, in time, be perfected, but human beings will always be human beings, subject to the ills and weaknesses of mankind. Some will be capable of developing into good flyers; some will not. To prevent accidents, therefore, the most important step is to find some method whereby those unfit for flying may be weeded out before they can do any damage to themselves or others and whereby flying may be limited to those who may be reasonably expected to meet successfully any emergency that might arise.

About 35 per cent of all accidents are due to faults of the personnel engaged in operating aircraft. A large percentage of these will be eliminated when the proper method of selection is found. Constant search is being made for this ideal method. So far, it has not been found, but the quality of those engaged in the search is such as to justify the belief that it will be—and soon.

Among those who are working on this subject is Wing Commander T. S. Rippon, O. B. E., R. A. F., a psychologist of note, as well as a flyer of long experience.

At the Ghent Congress of the Royal Institute of Public Health, June 1, 1927, Commander Rippon read a paper entitled "The personal factor in flying," in which he brings out the necessity for the flight surgeon to "know his man." Commander Rippon has courteously granted permission for the BULLETIN to publish the outline of his paper, which follows:

### IMPORTANCE OF THE "FLYING TEMPERAMENT"

In this paper it is proposed to emphasize the importance of the psychological examination of aviators who are required for military flying or exceptionally arduous work, such as racing or flying the Atlantic.

Whilst it may be taken for granted that such men as Lindbergh are undoubtedly physically fit, what impresses us particularly is their personality or mental make-up.

Those of us who have lived in close touch with airplane pilots know that their emphatic view is that the "flying temperament" is the mark of a successful aviator. Further, they consider that those who possess special aptitude for flying should be allowed to qualify as pilots even though they may have some minor physical defect.

### CLASSIFICATION OF AIRPLANE PILOTS

It is convenient to classify pilots as follows:

Average aviators.
Superaviators.
"Crashers."

The "Crasher" class can be detected by the medical examination, and consist of the following types: The erratic lander suffering from defective vision, the individual who faints at high altitudes, those who become dizzy or lose consciousness in spins or rapid rotary movements, those whose light sense is poor and who can not see when the light is dim, or at night, and, finally, those who can not endure fatigue.

Superaviators are individuals who possess the "flying temperament." Amongst other qualities they possess good "hands" so that they control an airplane with the same ability as a skillful jockey controls his horse. They have a sort of instinctive or automatic foresight, and alert power of attention.

### THE "FLYING TEMPERAMENT" DESCRIBED

During 1917 and 1918, with the help of an experienced pilot, I investigated the mental qualities and characteristics of a number of successful military pilots, and will briefly summarize them:

Sport.
Judgment.
Courage.
Alertness.
Youthfulness.
Self-possession and confidence.
Adventurousness.
High spiritedness and vitality.
Love of open-air life.

### REMARKS

These qualities named explain themselves, with the following exceptions:

1. *Judgment.*—By this is meant the power to decide on the right action to take in emergency, and to act without mental flutter (not to "lose his head").

2. *Youthfulness*, i. e., youthful disposition.—Disregard of the consequences of danger, and optimism. When off duty inclined to be irresponsible and happy-go-lucky individuals.

3. *Self-possession and confidence.*—All these pilots had a marked personality. They were "dominants," and without being aggressive in manner gave the impression of strength. The knowledge of their ability to deal with a situation involving personal combat was demonstrated by an air of justified confidence in themselves.

### METHOD OF EXAMINATION TO DETERMINE MENTAL APTITUDE FOR FLYING

No satisfactory method has yet been introduced to test aptitude for flying, apart from an actual flight with an instructor, and a great opportunity awaits some investigator to provide a true "trade test" for flying.

My own method depends largely on a knowledge of the mental make-up of several hundreds of successful pilots and unsuccessful pupils.

I start with the assumption that the essential characteristic of a successful pilot is the possession of a suitable temperament, which I estimate by means of a carefully planned questioning into his early life, disposition, likes and dislikes, habits, and amusements. Finally, I grade him as average, above average, or temperamentally unfit, according to whether he possesses the mental qualities previously described or not.

This "personality study" method was approved by the late Dr. W. H. R. Rivers, F. R. S., who acted as consulting psychologist to the R. A. F. in 1917–1919, and is referred to in a report on temperament which was published in 1919 by the Air Ministry.

### MENTAL TESTS

I have obtained useful information from certain mental tests which I will briefly describe.

1. *The domino test.*—This test consists of playing a game of dominoes single handed, as quickly as possible, the observer taking the time by a stop watch and noting the quality of the work as well as the speed.

The examiner estimates mental alertness, ability to concentrate, spread of attention, and observation by the way the subject does the test.

2. *The visual apprehension test.*—In this test, a group of 10 small objects, familiar to all subjects, such as a pencil, coin, bunch of keys, spoon, cigarette, etc., is placed on a table and covered with a cloth. The subject is told that he will be given six seconds to view them, after which he will be asked to enumerate them.

As soon as the six seconds have elapsed, the objects are covered again.

This type of test is variously called a test of "quick perception," of "observation," or "degree of attention."

3. *Estimation of reflex reaction-time.*—My experience has been that if a large number of pilots are tested by visual, auditory, or tactile signals, it will be found that in the majority of cases very little information has been obtained.

Certain individuals, however, stand out prominently as exceptionally quick and consistent. These are often found to be well-known "aces."

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## A NEW BLOOD-COUNTING METHOD

"Preliminary report of a modified method of blood-counting for the determination of inflammatory conditions," is the self-explanatory title of a paper by Kingsley Roberts, Ph. B., M. D., of the Fifth Avenue Hospital, New York, which was published in the September, 1927, number of The American Journal of Surgery.

The author, realizing that the ordinary white-blood-cell and differential-cell counts, with their permissible limits of error, often fail to settle the question of the presence or absence of an acute inflammatory condition, and may be misleading, has felt the need for

some method of blood-counting which would be a real aid to arriving at a decision, and doing it quickly. This paper is, as its name implies, a preliminary report of such a method devised by the author. It is based upon a differentiation of lobulated and nonlobulated forms of polymorphonuclear neutrophiles.

As the writer says:

> The myelocyte is continually developing into, amongst other cells, the polymorphonuclear neutrophile. This change is accomplished by the addition of neutrophilic granules to the cytoplasm and the typical metamorphosis of the nucleus which eventually assumes the characteristic shapes that give the polymorphonuclear neutrophile its name.

It is obvious that between the mononuclear myelocyte and the polymorphonuclear neutrophile there must be several stages in the development of the nucleus. At some stage, "some portion of the nuclear mass is almost completely pinched off from the main nucleus." The author makes use of this stage in his method of counting. He defines a lobulated polymorphonuclear as "one in which some portion of the nuclear mass is separated from the main nuclear mass by a strand of chromatin, both sides of which are not distinctly visible under the two millimeter oil immersion lens." That this classification is easily understood is claimed by Roberts.

The technique of the count is the same as for all differential counts, cover glass preparations being used. After the ordinary differential count has been made, 100 polymorphonuclear neutrophiles are counted on each cover glass and the percentage of nonlobular forms is determined.

An examination of 118 normal individuals in New York during December showed about 25 per cent of the nonlobular forms. This number is considered the average normal, and Roberts considers that the presence of 25 per cent, or less, of the nonlobular forms indicates that there is no inflammatory process present in the individual.

Working with rabbits, which were found to have about the same percentage of nonlobular forms as man, a study to determine the effect of inflammatory conditions on the percentage was made. It was found that, even in the stage of leucopenia which followed the injection of live, pus-forming bacteria into the peritoneal cavity, the percentage of nonlobular forms commenced to rise almost at once and kept mounting until death or recovery ensued.

The author has a series of only 50 clinical cases upon which to base his conclusions, but in all cases in which counts have led to the diagnosis of an inflammatory condition this has been confirmed at operation. As a result, he feels justified in "making the statement that if a nonlobular determination reveals the presence of 35 per cent or more of these forms an inflammatory process is present somewhere in the body."

As a possible explanation of these phenomena, the author offers the theory which follows: "* * * When the call for phagocytes comes, the white blood cell-forming organs pour into the circulation their available polymorphonuclear neutrophiles. These polymorphonuclear neutrophiles being of the younger variety, fall into the nonlobular group. Hence, before the total number of white cells or the percentage of polymorphonuclears has risen to the point where it is clearly indicative of an inflammatory process, a determination of the nonlobular forms present will give this desired information."

In order to test his theory, the author makes a "nonlobular determination" upon patients suffering from inflammatory diseases at frequent intervals over a period of two or three weeks. He has found that so long as the percentage of nonlobular forms remains higher than normal, or is rising, the prognosis must be guarded, since this means that the white blood cell-forming organs are being overtaxed. The reverse of this has also been found to be true. If the percentage of nonlobular forms decreases, the prognosis is good.

The writer states that his number of cases studied is too small to prove his theory, and the preliminary report has been made in the hope that it will stimulate other workers to try the method.

## THE MASTER SPECIALTY

Commander K. C. Melhorn, M. C., United States Navy, sanitary engineer of the Republic of Haiti, recently made a brief address before the Haitian Medical Society. He chose for his subject, "The Master Specialty," meaning by his title "good histories and good physical examinations." As brought out in his address—which follows—these two are essential to the successful application of the physician's art. Commander Melhorn said:

I thought it might be of interest this evening to give a brief description of a general practitioner's method of conducting clinical studies that has stood the test of flour and one-half years' daily trial.

Five years ago it was my privilege and pleasure to spend four months in most delightful postgraduate work at the Massachusetts General Hospital—one of the teaching units of the Harvard Medical School. The studies were pursued in clinics associated with the well-known work of Dr. Richard Cabot—one of the leading internists of the United States.

The most satisfying experience of all was to note on every hand the insistence on careful histories and physical examinations of all patients within the hospital or in the out-patient department, no matter how trivial the presenting symptoms might appear to be. In the maze of specialties surrounding us these days it is certainly comforting to find oneself in an atmosphere where these two factors, that any doctor can observe, occupy the most prominent positions of all. Good histories and good physical examinations have been preached in medical schools and medical meetings for years and years,

but what a scarcity of them is found in the work-a-day world of a doctor's life! In the clinic that I refer to, though not designated as such, they are classed as "master specialties" to be employed in 90 per cent of a general practitioner's work. After all is said and done he is the one who sees and treats the majority of patients the world over.

I therefore urge those of you who are attracted by the hue and cry of "specialism," not to overlook (as so many doctors do) the fact that the specialist in "history taking and physical examinations" never has an empty office or an idle professional hour. Once the public knows that you are a doctor who will not only take the time to listen attentively and sympathetically to its story, but will also conduct a personal inquiry and a physical examination, the like of which few have ever experienced before, your reputation is made and success is yours. Only the doctor who is a student and abreast of the times does that type of work—a type that an educated public is demanding more than ever before. The medical organization or group clinic that fails to include this "specialty" in its midst is a misnomer and is now being evaluated accordingly.

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## FLOCCULATION VS. WASSERMANN TESTS IN THE SEROLOGIC STUDY OF SYPHILIS

The symposium section of the International Medical Digest for October, 1927, is given over to a discussion of the relative values of flocculation tests and Wassermann tests in the serologic study of syphilis.

The writer directs attention to the fact that the diagnosis and treatment of syphilis is not a closed question; that clinical observation in syphilis is being neglected by many physicians because of their complete dependence upon the laboratory for diagnosis and guidance in treatment; and that syphilis is, of all diseases, "the most protean in its manifestations."

Further, he says, " * * * the Wassermann test, when properly performed by a competent serologist using a reliable technic, constitutes the most delicate and constant single symptom of syphilis." It is admitted, however, that the Wassermann test is difficult of execution and this has led to many attempts to simplify it or to find some substitute for it. The Kahn test is one of these.

The Kahn test, in the opinion of the writer, shows an agreement with the Wassermann test in from 90 to 95 per cent of cases. As an additional means for the serologic study of syphilis, he admits its value, but he finds fault with the demands of some of its proponents that it be made the exclusive test for use in syphilis.

Among the reasons given for the rapid spread of the agitation in favor of the Kahn test are: (1) Its simplicity has been stressed and many have, accordingly, been led to believe that it is a test which may be performed by anyone with slight training. This, of course, is not true. In order that the test may be of real value it must be

performed with great care and by some one thoroughly familiar with it. (2) Its adoption by the Navy and by the Michigan State Department of Health. The former is easily understood, as the test is one which may be performed aboard ships where it would at least be difficult to carry out the Wassermann technique.

The writer fears that the adoption of the Kahn test for syphilis might be disastrous to the patient; who is, after all, the one most intimately affected. For this reason, he states "the major premises upon which the exclusive adoption of the Kahn test is urged" and gives his answers thereto. Briefly, they are as follows:

"I. Rapidity, in that the entire procedure can be completed within a very few minutes."

In reply to this, he questions the necessity for any such instantaneous diagnosis. Syphilis is a difficult disease to cure, and its treatment is slow and tedious. By the time the disease reaches a stage where a positive serologic reaction may be obtained, it has already reached a point where a few days' delay in diagnosis will do no harm. The only circumstance in which the writer considers that extreme rapidity of diagnosis would be of value is in testing the blood of a donor before transfusion.

"II. Simplicity of technic."

The impression that the Kahn test is so simple is extremely unfortunate and is untrue. True, the test itself is much more easily performed than is the Wassermann test, but it is the reading and interpretation of the result that is most important. This is not always easy in weakly reacting sera. The difficulty of performing the Wassermann test has a tendency to restrict its performance to those well qualified by training and experience. This is in its favor.

"III. Minimal time and labor required."

Granting this, the writer, as indicated above, sees no necessity for great haste. As he says: "So great, so far-reaching is the influence of a diagnosis of syphilis upon the future of the patient, so grave its aftermath, and so important its relation to his life, his family, his social and economic relations, and even his every-day existence, that it is essential to be sure rather than precipitate in the diagnosis. One should not regret whatever is necessary in time or labor to render the diagnosis free from error or to safeguard the treatment of this dreaded malady."

"IV. Delicacy and specificity."

As before stated, there is an agreement in from 90 to 95 per cent of cases between the Kahn and Wassermann tests as generally performed. False negative reactions may be obtained in either test. However, such reactions do not always occur simultaneously. One may be positive; the other, negative. This is a strong argument in

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favor of using both tests, rather than either one exclusively. False positives occur in from 3 to 5 per cent of Kahn reactions. This constitutes a real danger, as, in many cases, a laboratory report is accepted as final in diagnosis.

Neither the Kahn test nor the Wassermann test should be thought of as "a test for syphilis." Rather are they "laboratory methods of examination for evidence of reaction to syphilis."

Finally, the writer says:

> A blind and unquestioning acceptance of any serologic procedure as constituting in itself a thorough, complete, final, or infallible examination for evidence of syphilis, or the acceptance of the Kahn test as suitable for such a purpose, is greatly to be deplored and may be vehemently denied.
>
> The Kahn test is no more suitable for general, haphazard employment than is the Wassermann test, and, while under circumstances preventing the accurate application of the Wassermann test, to do a Kahn test is better than to do none, the proper place and true value of the Kahn test is as an additional serologic method for the study of syphilis, to be used by well-trained and thoroughly grounded workers with and not in place of the Wassermann test.

### PSYCHASTHENIA

Recently, at one of our naval hospitals, a private marine was discharged from the service, upon recommendation of a Board of Medical Survey, with the diagnosis, "Psychoneurosis, psychasthenia." This marine gave a history of having contracted syphilis in 1918, for which he received six injections of salvarsan and a course of mercury extending over a period of six weeks. Apparently, no other treatment was given, probably because of expiration of enlistment in 1919. There was also a history of opium smoking in 1924 and 1925, so there is sufficient background for the development of mental disorder in 1927. At the time of his discharge he showed defective mental control, had obsessions and phobias and fixed ideas, and was greatly introverted. The thing that directed attention to his mental condition, and that eventually led to his discharge from the service, was a letter written by him to the medical officer of the station at which he was serving. Rarely has a letter been seen which better shows the mental processes of a man developing psychasthenia or in the early stages of a mental breakdown. For this reason the letter which follows is quoted in full.

> DEAR SIR: It is despair and not disrespect that prompts the writing of this letter. I am fully conscious of the breach of military etiquette that I am guilty of in soliciting your attention unofficially, but pride, or that mythical something which is termed self-respect, makes it impossible to present my case in any other manner. Feeling as I do that my ailment is rather mental than physical, I have chosen the written word in preference to the oral, in giving you an expression of my case.

Humanity in its ruthless pursuit for the materialistic ends of our existence has little time or understanding for those who accidentally fall victims to intellectual afflictions. Like Emerson, I believe that nothing "is, alas, sacred but the integrity of the mind." When one feels that this integrity is becoming impaired, and in imminent danger of being dethroned, the instinct of self-preservation arrays itself with the forces of reason, which dictate but one solution, namely, self destruction. Being, as we are, a strange comixture of intellect and flesh, we can not be impartial to either, nor can we ignore the legitimate claims that each justly merit. Torn between these warring claims of mind and body, I have become a victim to morbidity and abject despair, in this battle I feel that I can no longer cope single-handed, and it is the purpose of this letter to call upon you for help that your profession might be able to render.

The honest pride and self-respect that are the by-products of education, have made me conceal my pitiful, mental condition for many years. It is an overwhelming catastrophe to an intellectual man to face, even remotely, the possibility of insanity. How much more acutely must be the despair, when insanity is not remotely possible, but actually experienced, in unguarded moments of mental relaxation. It is only through a supreme effort of the will that I am able, from day to day, to retain the semblance of normalcy. The struggle to repress the wild and fantastic thoughts that assail me, presents itself daily and even though by sheer will power, I experience a small measure of success, I feel that the nerve energy necessary for this incessant strife, is beginning to exhaust my body. Recently, this has become very pronounced. I have a very trying time to remember things. In the general routine of the office, the minor details which constitute the greater portion of my work are becoming to be inefficiently done, not through any desire on my part, but because being too proud to admit that the small scope of intelligence necessary to remember them, is strangely lacking in me. I chance my work, there is no certainty about it, no thoroughness. In years gone by, my personal appearances and bodily cleanliness were religiously observed, but of late, a slovenness engulfs me, perhaps only noticeable to myself, but enough to indicate that I am no long the same man. In moments of mental aberration, I am completely oblivious to my surroundings, or any event that might transpire about me. My well-meaning shipmates pay little attention to this, merely passing it off as "dopiness." But to a man who has always been a keen observer of all that goes on about him, it is the "writing on the wall." To lie awake at night until two or three in the morning is a common occurrence. Arising in the morning with a constant headache, and with every muscle in my body unwilling to exert itself. I have been an omnivorous reader, but lately this mental recreation is no longer mine, for the power to concentrate on what is before me is gone, and I find that many times I have read two or three pages, without being aware of the nature of the subject perused. I am still sane enough to recognize that these idiosyncrasies are abnormal, and that being so unnatural to me, must have some deep-rooted cause that needs professional attention.

The delay in reporting to the medical authorities my case has been prompted by pride, it is hard Sir, to bring such a delicate affair to the notice of anyone. If I were not obligated, under oath, to the service, the secret of my mental decline would go down with me to the grave, but sensing that should my malady taken violent form, I jeopardize others, and knowing that self-destruction, which at many times appears as the happy solution, would be cowardly, while still in the service, and feeling, sincerely that the symptoms of my affliction are growing alarming of late, the only honorable way was to report it. If I

**have seemed presumptive in bringing my case before you in letter form, it is because the delicacy that breeding gives, makes it easier to write of such things in preference to speaking of them in person.**

**Trusting that you will overlook the breach of military etiquette by remembering the motive that incited it, I am Sir,**

**Respectfully,**

——— ———.

### DRY STERILIZATION

The usual method of sterilizing surgical instruments in boiling water has never been entirely satisfactory, because of the difficulty encountered in drying the instruments after boiling, in preventing rust, and in avoiding injury to the points and edges of knives. In spite of this, the method has been persisted in in all countries except France, where dry sterilization is largely practiced. It is particularly important that instruments used in eye operations should not be subjected to the risk of being dulled by boiling. That this is recognized is shown by the fact that sterilization with phenol is resorted to by most eye surgeons. However, even this method of sterilization is not to be recommended too highly, as, at best, it is uncertain in its results.

The facts which have been stated are brought out in a paper entitled "Dry sterilization for eye instruments," by William C. Finnoff, of Denver, Colo., which was published in the American Journal of Ophthalmology, August, 1927. In this paper, Finnoff describes the method he uses for sterilizing the instruments employed in intraocular work and work on the ocular muscles, and states that, "It has entirely eliminated the apprehension of finding damaged or contaminated instruments."

The method of sterilization is as follows:

> The knives are fixed in holders, which are placed in corked test tubes. The other instruments are arranged in metal boxes, which have tight-fitting covers. Hypodermic syringes, that have been previously dried and the plungers inserted into the barrels, are placed in corked test tubes. Each container is wrapped in paper and labeled. The instruments in their containers are then placed in an electric sterilizer that is automatically controlled by a thermostat, which keeps the temperature at 160° C. (320° F.). The exposure should be for one-half hour at this temperature. They are then removed and one can feel assured that all organic life has been killed.

The paper covers are used to prevent the entrance of dust and are carefully removed from the containers before they are handed to the surgeon.

Dr. Robert Amory in 1909 determined the efficacy of dry sterilization, using contaminated orange wood sticks for the purpose. He found that exposure to dry heat from 121° C. (250° F.) to 149° C.

(300° F.), for 40 minutes, destroyed all spores and did not injure the wood. If there are no spores present, a shorter exposure will, of course, suffice. Fine steel wire and watch springs are not injured by temperatures that will destroy spores.

As the writer says, this method is ideal for hypodermic syringes and needles, scalpels, probes, and similar instruments, and there is no reason why it should not be used for general surgical instruments. Where the same instruments must be used for two or more operations in quick succession it is, however, not practicable.

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### HOT BATHS IN THE TREATMENT OF SYPHILIS

Increasing the body temperature by various means has become an accepted measure of therapeusis in the treatment of diseased conditions. The artificial inoculation of patients with malaria and sodoku, as well as the elevation of temperature by means of hot baths, have been commented upon by the BULLETIN from time to time, and reports of experiments have been made.

In the January, 1927, number of this periodical an abstract of the report of the work of Schamberg and Rule on the therapeutic effect of fever in experimental syphilis was published. The work of these investigators was done with rabbits and the results obtained by them were sufficiently encouraging to lead to clinical trails upon human beings with naturally acquired syphilis.

In the American Journal of Syphilis for July, 1927, Drs. Jay F. Schamberg and Hsien-wu Tseng report the results of such work recently caried on by them, under the title, "Experiments on the therapeutic value of hot baths with special reference to the treatment of syphilis, and some physiological observations." The summary of their report follows:

1. The above studies were undertaken because of the striking protective and curative results of hot baths in experimental syphilis in rabbits.

2. The laboratory results were such as to warrant clinical trial on human subjects. The technic employed and the type of case to be treated had to be determined by us by trial.

3. We have proved that it is possible to raise the body temperature by hot baths even as high as 106° F., and furthermore to do so safely.

4. In most cases there has been a perceptible improvement in the cutaneous manifestations, sometimes to the point of disappearance of lesions.

5. There seems to be a slight improvement in the Wassermann reaction, although we would not insist too much upon quantative alterations.

6. We draw no definite conclusions from the above studies, realizing that a much larger series of cases must be studied over a long period of time.

7. It is not our expectation that hot baths alone will prove of curative value in syphilis. It is possible, however, that used as an adjunct to other methods they may prove to be of therapeutic aid.

8. With respect to the physiologic studies made, we would summarize as follows:

Very hot baths cause—

(*a*) A transient leucocytosis, followed by a brief reduction in the white cells.

(*b*) A slight rise in systolic blood pressure and frequently a great drop in the diastolic pressure, both of temporary duration.

(*c*) A fall in the blood cholesterol averaging about 10 per cent.

(*d*). A rise in the blood sugar averaging about 10 per cent.

(*e*) No material influence upon the urea nitrogen, blood uric acid, or proteolytic or lipolytic enzymes.

## BARBITAL

A report of three cases of poisoning by barbital, used in therapeutic doses, is made by A. C. Eitsen, M. D., in The Journal of the Kansas Medical Society for October, 1927. Barbital is usually considered a safe remedy. That care is necessary in its use is well illustrated by this report.

The first patient was an old man, aged 84, who took two 5-grain tablets one night upon retiring. He was in good physical condition at the time, but had been troubled with sleeplessness. When seen on the morning following the taking of the tablets, he was completely disoriented. For several days he was maniacal and the condition took nearly a month to clear up.

The second case, a woman, aged 66, who suffered from acute bronchitis and mild diabetes, took one 5-grain tablet. The next morning she was completely disoriented. In this case, the condition cleared up in about three days.

The third patient described was an old lady, aged 83, who had a general pruritis and other senile changes. She took barbital in 5-grain doses on several occasions. Always, on the day following, she had muscular incoordination to such a degree that she was unable to walk.

It is true that these patients were all older than the patients with whom naval medical officers have ordinarily to deal. However, it is well to know that such symptoms may be caused by barbital and that caution should be observed in prescribing the drug.

## PARIS GREEN AND CULICINE LARVÆ

Paris green, mixed with road dust and "dusted" upon the surface of ponds by airplane, has been found effective against the surface-feeding larvæ of Anopheles mosquitoes. Used in such a way, however, it does not kill the larvæ of Culex, Ædes, and other mosquitoes. In order to determine the toxicity of Paris green for these latter

types, and to develop a method for its use if found effective, K. Padmanabha Ménon, of the Ross Institute, London, carried on a few laboratory experiments at that institute, and published his findings in The Journal of Tropical Medicine and Hygiene, August 2, 1927.

Paris green, when sprinkled on water, does not sink, because of the surface tension. If, however, it be shaken with water in a test tube, to wet the granules, the surface tension will be overcome and the granules will sink to the bottom. This was done by Menon, who found that in dilutions of 1 in 10 to 1 in 40, with algæ, débris, mud, etc., Paris green killed most of the grown-up larvæ of Culex and Ædes in from 12 to 24 hours. Examination of the alimentary tube of the dead larvæ showed the presence of arsenic.

The author summarizes his paper as follows:

"Paris green, when vigorously shaken with water, can be made to sink. Culicine larvæ, which feed from the bottom, swallow the granules of Paris green with particles of food and die. Larvæ which are in the very early stage of development seem to escape. Paris green is not toxic to mosquito pupæ. Larvæ of other insects like chironomidæ may be affected."

The experiments could not be carried further because of the author's return to India, where he hopes to continue them and apply them in the field.

It is suggested, as a result of these experiments, that Paris green, after being well shaken with water, should be sprayed upon the surface of shallow ponds and collections of water. It has been shown that the solubility of Paris green is so slight that, in the quantity used, it will be harmless to fish and cattle. There is no accumulation of arsenic in the water, as Italian workers have shown that it is eliminated within 48 hours by some natural biological process.

## QUERIES

Beginning with the April, 1928, issue of the HOSPITAL CORPS QUARTERLY, a query section will appear under the heading "Information for the Hospital Corps," and will be devoted to the publication of questions and answers on the subjects of general education, professional matters, personnel, reports and returns, regulations, and interpretations. Questions of such nature will be published in the order received, followed by the answers.

It is intended that the QUARTERLY serve the Hospital Corps as a vehicle of enlightenment that tends to further their efficiency in the performance of their professional duties, a medium for the inter-

change of professional ideas and experiences, and a means of official communication to the Hospital Corps.

The source of publication of the QUARTERLY furnishes almost unlimited references from which answers can be prepared to almost any questions, of the above nature, that may be asked by members of the Hospital Corps. Therefore, all members of the Hospital Corps are urged to take advantage of this opportunity.

Questions should be typewritten, or printed on one side of paper, with name, rate, and station at the close of question—names will not be published. Address all such communications to the Editor, the HOSPITAL CORPS QUARTERLY, Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

# BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.
(For review.)

CLINICAL PHYSIOLOGY, by *Robert J. S. McDowall, D. Sc., M. B., F. R. C. P. (Edin.), Professor of Physiology, King's College, University of London.* With an introduction by *W. D. Halliburton, LL. D., F. R. C. P., F. R. S., Emeritus Professor of Physiology, King's College, University of London.* D. Appleton & Co., New York, 1927

At the present time, when a strenuous effort is being made to revise the curriculum of medical schools in order that the basic sciences of anatomy, physiology, pharmacology, biochemistry, bacteriology, and pathology may be extended into the third and fourth years of medical teaching, this volume should excite peculiar interest among practitioners of medicine and particularly among teachers in medical schools.

There has been a tendency in the past to relegate the study of physiology to the first and second years of the medical course and the application of physiology to the later years of study has been somewhat vague.

The author presents the science of physiology in such an attractive and practical manner that it can be carried to the bedside and applied clinically, which, after all, is the acid test for any medical science. The book provides most interesting reading and the author states in his preface that it is intended primarily for senior students and practitioners of medicine whose time for reading is limited and who perhaps will not consult the more exhaustive monographs on the subject.

It is difficult to see how any student of medicine could read this volume without tremendous profit to himself. The author has attempted to cover the entire field of clinical physiology, which in itself is a tremendous task, and some of the subjects dealt with may perhaps not be treated so exhaustively as some readers would wish.

The contents are conveniently divided, under appropriate headings, so that reference is greatly facilitated.

There is a chapter on the physiological principles in the treatment of certain emergencies which can be read to advantage.

This volume is a new departure and somewhat different from any other book on the subject. It is considered that the author's attempt to make physiology a practical subject which can be carried to the bedside and applied clinically deserves commendation.

The book might well constitute part of the library of every medical student, in spite of the fact that the average student is hard pressed for time for additional reading.

OSLER'S MODERN MEDICINE, edited by *Sir William Osler, Bart., M. D., F. R. S., late Regius Professor of Medicine in Oxford University, etc.* Third Edition, thoroughly revised, reedited by *Thomas McCrae, M. D., Professor of Medicine in Jefferson Medical College, Philadelphia; Fellow of the Royal College of Physicians, etc.*, assisted by *Elmer H. Funk, M. D., Assistant Professor of Medicine, Jefferson Medical College, etc.* Volumes IV and V. Lea & Febiger, Philadelphia, 1927

Volume IV treats of diseases of the respiratory system and diseases of the circulatory system, while in Volume V, diseases of the blood, diseases of the lymphatic system, diseases of the ductless glands, diseases of the urinary system, vasomotor and trophic disorders, and diseases of the locomotor system are discussed.

The various disease conditions are grouped about as they were in the earlier editions and, with few exceptions, the same authorities have written the different chapters.

It is needless to say that these volumes will be found as valuable for purpose of reference as the other volumes of this edition and the volumes of the earlier editions.

PHYSICAL DIAGNOSIS, by *Richard C. Cabot, M. D., Professor of Medicine in Harvard University; formerly Chief of the West Medical Service at the Massachusetts General Hospital.* Ninth edition. William Wood & Co., New York, 1927

Any book which is in its ninth edition in a little over 20 years is certainly abreast of the times and is so well known to the profession that no introduction is necessary. And this would seem to be especially true of a book which has served as the basis of instruction for such a large percentage of medical men. The present edition has followed the make-up and appearance which has become so familiar, the changes being those of revision to bring the work up to date. The sections on cardiovascular disease, tuberculosis, and the blood have seen the most change. The section on cardiovascular disease impresses this reviewer as being especially worth while for

medical officers. Certainly, fewer diagnoses of primary mitral regurgitation will be made by anyone reading this section, and that factor alone will materially reduce the number of erroneous diagnoses and the amount of anguish experienced by those who have been told that they have "heart trouble" or "a leaking valve."

APPENDICITIS, by *Hubert Ashley Royster, A. B., M. D., Surgeon to Rex Hospital; Surgeon-in-Chief, St. Agnes Hospital, Raleigh, N. C.; former President Southern Surgical Association.* D. Appleton & Co., New York, 1927

The author has reviewed an extensive bibliography with special attention to important papers on this subject published within the last five years.

Special emphasis is directed toward the early diagnosis and treatment of this disease. Operative methods are fully discussed and well illustrated.

The Ochsner method of treatment is fully discussed. This discussion and the conclusions reached should remove many of the misconceptions so prevalent as to the type of case in which this method was recommended and what it hoped to accomplish.

A commendable attempt is made to arrive at accurate mortality statistics in this disease.

This monograph should be of help to the general practitioner as well as to the surgeon.

MANUAL OF SURGERY (ROSE AND CARLESS), by *Albert Carless, C. B. E., M. B., M. S. Lond., F. R. C. S. Hon. Fellow, American College of Surgeons; Emeritus Professor of Surgery, King's College, London, etc.,* and *Cecil P. G. Wakeley, F. R. C. S. Eng., F. R. S. Edin., Erasmus Wilson Lecturer, Royal College of Surgeons of England; Assistant Surgeon, King's College Hospital, etc.* Twelfth edition. William Wood & Co., New York, 1927

Rose and Carless has been the standard English text-book of surgery for so many years that a complete review of a new edition is unnecessary. It is sufficient to say that the twelfth edition, which has become necessary after a lapse of only three years since the publication of the eleventh, lives up to the high standard which has characterized the earlier editions.

For the first time Mr. Wakely appears as a full collaborator with Mr. Carless.

A single volume of more than 1,500 pages is unavoidably bulky and difficult to handle, but the surgeon who uses this volume as a reference book will find himself well repaid for the slight inconvenience to which he is put in handling such a large book.

The illustrations throughout the text are adequate and those in the radiographic supplement are excellent.

TROPICAL SURGERY AND SURGICAL PATHOLOGY, by *Karuna K. Chatterji, F. R. C. S. I., Major, I. T. F. Medical Corps; Surgeon, Medical College Hospitals, Calcutta; Fellow of the Royal Society of Medicine, London, and of the Royal Society of Tropical Medicine, London; etc.* With a foreword by *Maj. Gen. Sir R. Havelock Charles, G. C. V. O., K. C. S. I., M. D., LL. D., M. Ch., F. R. C. S. I., I. M. S. (Ret.), Sergeant-Surgeon to His Majesty the King; Physician-in-Ordinary to His Royal Highness the Prince of Wales; late Dean of the School of Tropical Medicine and Hygiene, London; etc.* William Wood & Co., New York, 1927

Reviewers of detective stories and other novels are wont to relate that they picked up the book to glance through it and were unable to lay it down or even stop to eat or drink until they had read it to the last page. Such, with very minor reservations, was the effect of Chatterji's Tropical Surgery on the present reviewer. It is full of interesting personal experiences, side lights on the people and customs of India, interracial amenities and historical observations, interspersed with the clinical observations. How the reviewer would have prized such a book as this, back in the days of his own tropical duty, when he was beginning to do surgery.

One assumes from the author's name that he belongs to the indigenous race and so his comments concerning the effect of alcohol on the white man in the Tropics are most illuminating and probably unprejudiced. The remarks, on pages 23 and 24, about the adjustment of the European to life in the Tropics, might well be read by all officers on their way to such duty. The incidence of neoplasms in the Tropics is an important subject and one of controversy, since a layman recently produced a most interesting book in which one of the premises, on which he based his conclusions as to the nature and cause of cancer, was that cancer does not prevail among primitive races. This book contains a thorough discussion of the subject.

Section 1 covers the subject of amœbiasis; section 2, filariasis; section 3, tropical granulomata; section 4, schistosomiasis; section 5, ascariasis; section 6, bones and joints; section 7, abdominal surgery in the Tropics; section 8, neoplasms in the Tropics; section 9, vesical calculi, deformities due to burns, snake bite, and injection of saline solution in cholera.

This book should be in the library of all ships and hospitals in the Tropics.

BLOOD-PRESSURE; ITS CLINICAL APPLICATIONS, by *George William Norris, A. B., M. D., Professor of Clinical Medicine in the University of Pennsylvania, etc.; Henry Cuthbert Bazett, M. B., B. Ch. (Oxon.), F. R. C. S. (Eng.) Professor of Physiology in the University of Pennsylvania,* and *Thomas M. McMillan, A. B., M. D., Assistant Physician to the Pennsylvania Hospital; Cardiologist to the Philadelphia General Hospital; etc.* Fourth edition, thoroughly revised. Lea & Febiger, Philadelphia, 1927

Because of the rapid advance in knowledge of the subject of blood pressure, the authors have found it necessary practically to rewrite

the book in order to bring out this, the fourth, edition. The literature of the subject, both practical and theoretical, has been carefully reviewed and incorporated in the work, which will be of material assistance to any physician.

All phases of blood pressure are discussed, and a definite course of procedure to be followed in any case is given.

Altogether, this is an excellent book to be used by anyone studying the complex subject of blood pressure.

DIAGNOSIS AND TREATMENT OF DISEASES OF THE STOMACH, by *Martin E. Rehfuss, M. D., Assistant Professor of Medicine at Jefferson Medical College, Philadelphia.* W. B. Saunders Co., Philadelphia, 1927

Minute details of the diagnosis and treatment of gastric conditions are gone into by the author, and fundamental points concerning the diseases of other organs of the digestive tract are given. Prominent specialists have contributed chapters on various phases of the subject.

The book is well written, easily read, and adequately illustrated. There are more than 500 illustrations, some in colors.

The past 20 years have brought about a tremendous change in the study of digestive diseases. Many aids to diagnosis and methods of treatment have been accepted as standard. These are described in detail by Rehfuss. Other methods, still under consideration, are discussed and the author's opinion concerning them is given.

BRONCHOSCOPY AND ESOPHAGOSCOPY, by *Chevalier Jackson, M. D., Sc. D., LL. D., F. A. C. S., Professor of Bronchoscopy and Esophagoscopy, Jefferson Medical College; Professor of Bronchoscopy and Esophagoscopy, Graduate School of Medicine, University of Pennsylvania, etc.* Second edition, reset. W. B. Saunders Co., Philadelphia, 1927

We are indebted to Doctor Jackson for so great a part of the knowledge, instruments, and technic of this important branch that it may be termed a one-man specialty. No other man can speak with as great authority, for no other has a comparable background of anatomical knowledge, clinical experience, and technical skill. His clinic for the use, development, and diffusion of knowledge of his specialty is one of the big things of America.

The book contains descriptions of the instruments and the methods of their use; solutions of the common problems of foreign body removal; the methods of treating various diseases of the respiratory and digestive systems. The short chapter on tracheotomy is alone worth the price of the book.

Doctor Jackson's book should be in the library of every hospital and hospital ship.

ORTHOPAEDIC SURGERY, *by Royal Whitman, M. D., M. R. C. S., F. A. C. S., Surgeon to the Hospital of the Ruptured and Crippled, Consultant to St. Giles and St. John's Guild Hospitals, to Polyclinic Hospital and others, etc.* Eighth edition. Lea and Febiger, Philadelphia, 1927

In this eighth edition of his book, Doctor Whitman gives a résumé of the methods and current practices used in his work. Viewed from the angle of mechanical disabilities the grouping of material has followed the functional rather than the etiological standpoint. This is eminently rational, as the orthopedic surgery of to-day is certainly a mechanical science and is concerned with the restoration of the normal function.

The reviewer is impressed with the attention paid to early diagnosis and the explanations of the mechanics of deformities. These make the book of exceptional value to the general practitioner as well as the specialist, for the general practitioner is the first to see most of these cases. From the military standpoint the chapters on foot mechanics and deformities and collateral orthopedics afford profitable pages for study and are well worth the time spent on them. That part of the work devoted to the treatment of fractures and the avoidance of post-traumatic deformities is particularly valuable.

When a book reaches its eighth edition it has established a group of adherents and little can be added to the esteem in which they hold it. Doctor Whitman has covered this subject so fully and in such an excellent manner that we feel that this work should be added for reference to libraries in our hospitals. Undoubtedly, it will receive the recognition and use which it deserves.

AFFECTIONS OF THE STOMACH, by *Burrill B. Crohn, M. D., Associate Attending Physician to the Mt. Sinai Hospital, New York City; Member of the American Gastro-enterological Association; Consulting Physician, United States Veterans' Bureau, etc.* W. B. Saunders Co., Philadelphia, 1927

The modern conceptions of stomach diseases are based on years of elaborate study of the embryology, physiology, pathology, radiography, and chemistry of the organ. We no longer hear of the score of types of acute and chronic gastritis and dyspepsia which were formerly diagnosed.

In this volume we have, completely described, the anatomy, physiology, laboratory tests, radiography, symptoms and signs, pathology, and treatment of diseases of the stomach. There are 275 pages devoted to ulcer, every page of which is worth reading. From the standpoint of both physician and surgeon, ulcers and their treatment are fully discussed and careful reading fails to disclose any great divergence in their views. The chapters on surgical treatment are by Dr. A. A. Berg, a competent and conscientious writer, whose conclusions are important.

The book is a valuable summary of present knowledge of stomach disorders, of interest to internist and surgeon.

DISEASES OF THE MOUTH, by *Sterling V. Mead, D. D. S., Professor of Oral Surgery and Diseases of the Mouth, Georgetown Dental School; Professor of Diseases of the Mouth, Georgetown Medical School; Oral Surgeon to Georgetown Hospital; Dental Surgeon to Providence Hospital; Consulting Oral Surgeon to Casualty Hospital; Consulting Dental and Oral Surgeon to Shady Rest Sanatorium, etc., Washington, D. C.* The C. V. Mosby Co., St. Louis, 1927

Not being satisfied with his own qualifications for writing such a book, Doctor Mead has sought the advice and assistance of internists, general and dental surgeons, and laboratory workers. The result is a book which will be found useful to practitioners of both the dental and medical professions. It is the most elaborate, complete, and well-rounded work on this subject that has appeared in recent years.

EMERGENCIES OF A GENERAL PRACTICE, by the late *Nathan Clark Morse, A. B. M. D., F. A. C. S.* Revised and rewritten by *Amos Watson Colcord, M. D. Surgeon, Carnegie Steel Co.; Surgeon, Pennsylvania Railroad System; Ex-president, Association of Railway Surgeons, Pennsylvania Lines East; etc.* Second edition. The C. V. Mosby Co., St. Louis, 1927

From the standpoint of the naval medical service, medical books may be divided roughtly into four groups—first, those which should be in the library of the Naval Medical School; second, those which should be in the libraries of naval hospitals; third, those which should be issued to all ships and stations; and, fourth, those which every medical officer should own as his personal property.

The present volume falls into the third and fourth groups. It should be available at all ships and stations and every medical officer should have a copy to keep at his home and to carry when on leave or traveling.

The chapter headings include "Preparation for Emergencies," "Removal of Foreign Bodies," "First Aid," "Treatment of Asphyxiation," "Surgical Emergencies," "Medical Emergencies," "Fractures and Dislocations," "Obstetric Emergencies and Poisoning."

MINOR SURGERY, by *Arthur E. Hertzler, M. D., F. A. C. S., Chief Surgeon, Halstead Hospital,* and *Victor E. Chesky, M. D., F. A. C. S., Chief Resident Surgeon, Halstead Hospital.* The C. V. Mosby Co., St. Louis, 1927

It is always a pleasure to greet another book by Doctor Hertzler. He is an indefatigable writer with the ability to compress more practical points into a given volume than other writers. This present volume is of his characteristic sort, full of important facts, clearly expressed.

The book is designed to help the dispensary student to understand what he sees in the out-patient clinic. In the naval medical service

it should prove ideal for the interne or junior medical officer who is beginning his surgical service. Any young medical man would find this a most helpful book.

DISEASES OF THE EYE, by *Charles H. May, M. D., Director and Visiting Surgeon, Eye Service, Bellevue Hospital, New York, 1916 to 1926; Formerly Chief of Clinic and Instructor in Ophthalmology, College of Physicians and Surgeons, Medical Department, Columbia University, New York; etc.* Twelfth edition, revised. William Wood & Co., New York, 1927

So well is this book known to the profession, both English and foreign speaking, that a review of this, the twelfth edition, is almost superfluous.

The author stated in 1900, in the preface to the first edition, that "the great difficulty in preparing a book of this sort is to say enough but not too much." He has solved the problem admirably and throughout the book one senses not only an up-to-date specialist but a gifted teacher. It is a book which one likes to see in one's personal library for ready reference.

FEEDING AND THE NUTRITIONAL DISORDERS IN INFANCY AND CHILDHOOD, by *Julius H. Hess, M. D., Professor and Head of the Department of Pediatrics, University of Illinois College of Medicine; Attending Pediatrician to Cook County Hospital, etc.* Fifth edition. F. A. Davis Co., Philadelphia, 1927

This book has always been more of a working manual in pediatric practice than a textbook of academic interest. Among the introductory chapters is a good one on metabolism of infants. Breast feeding and nutritional disorders of the breast-fed infant are discussed within the space of 50 pages.

Eighty pages are devoted to artificial feeding, including a chapter on diets for ages from six months to six years. A section is devoted to the discussion of nutritional disorders in artificially fed infants.

Rickets, spasmophilia, scurvy, acidosis, and alkalosis, and anemias of infancy are discussed very lucidly.

The information furnished in the appendix is perhaps of as great value as that in the main part of the book itself. It is not readily found elsewhere.

The book will prove to be a useful aid to those medical officers assigned to family practice.

A TEXT-BOOK OF THERAPEUTICS, by *A. A. Stevens, A. M., M. D., Professor of Applied Therapeutics in the University of Pennsylvania; Visiting Physician to the University and to the Philadelphia General Hospitals.* Seventh edition, entirely reset. W. B. Saunders Co., Philadelphia, 1927

This author and his standard textbook have been so well known for so many years that a description of the nature of the book is unnecessary. The new edition has been entirely revised and conforms with the latest revision of the U. S. P., which became effective in 1926.

Many new drugs and remedial measures appear, for the first time, in this new edition.

The appearance of a new edition of one of Doctor Stevens's text-books is a matter of importance to every medical student and every practitioner. One of his outstanding qualifications as a teacher is his ability to express important facts clearly and concisely, so that they stick in the memory.

THE SCIENCE AND PRACTICE OF SURGERY, by *W. H. C. Romanis, M. A., M. B., M. Ch., Cantab., F. R. C. S. (Eng.), F. R. S. (Edin.), Senior Surgeon in Charge of Out-patients and Teacher of Practical Surgery, St. Thomas's Hospital; Surgeon to the City of London Hospital for Diseases of the Chest; Examiner in Surgery to the University of Cambridge, etc.*, and *Philip H. Mitchiner, M. D., M S. (Lond.), F. R. C. S. (Eng.), Surgeon in Charge of Out-patients, Teacher of Operative Surgery and Demonstrator of Anatomy, St. Thomas's Hospital; Lieut. Col. R. A. M. C. (T), Commanding Medical Unit, University of London O. T. C, etc.* William Wood & Co., New York, 1927

Volume 1, with 757 pages, is devoted to general surgery, and volume 2, with 921 pages, to regional surgery.

It is an ambitious enterprise these days to cover the whole field of surgery in less than 1,700 pages. It has been well done in this case, and there is little to criticize. The facts are stated clearly and concisely and there is no rhetorical padding. Regional anatomy, surgical pathology, laboratory tests, and after-treatment are described in an excellent manner.

This will prove a valuable reference work for the surgeon.

SURGICAL DISEASES OF THE GALL BLADDER, LIVER AND PANCREAS AND THEIR TREATMENT, by *Moses Behrend, A. M., M. D., F. A. C. S., Attending Surgeon to the Jewish and Mt. Sinai and Northern Liberties Hospitals; Instructor in Anatomy in the Jefferson Medical College; etc.* F. A. Davis Co., Philadelphia, 1927

An elaborate monograph covering the anatomy, physiology, pathology, symptoms, and treatment of the gall bladder, liver and pancreas.

Surgeons who handle many cases of biliary-tract disease will find it a useful summary of these conditions.

FISTULA OF THE ANUS AND RECTUM, by *Charles John Drueck, M. D., F. A. C. S., Professor of Rectal Diseases, Post Graduate Hospital and Medical School, Chicago.* F. A. Davis Co., Philadelphia, 1927

A description of the anatomical, pathological, physiological, and clinical aspects of fistula of the lower bowel. This is the result of a minute study of a large number of patients who were required to submit to more than one surgical operation for relief of fistula.

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Few conditions are more baffling to the general surgeon than the fistulæ about the rectum and anus which recur and persist in spite of his best efforts at treatment. This book is full of valuable ideas and practical suggestions. Any surgeon could profitably devote a few hours to a careful reading of this excellent monograph.

A TEXTBOOK OF EXODONTIA by *C. Dudley Gwinn, D. D. S., Assistant Professor of Oral Surgery, University of California, San Francisco, Calif.; Visiting Dentist to the French Hospital, San Francisco; Member of the Staff of the Stanford University, School of Medicine, San Francisco, Calif.* Lea and Febiger, Philadelphia, 1927

In the preparation of this book the author has endeavored to give in detail the several steps necessary for the correct procedure in exodontia which easily may be understood by the student. The original illustrations from practical cases are clear and are of valuable assistance to an understanding of the text. The book is of convenient size, of clear type on good paper.

STANDARD METHODS OF THE DIVISION OF LABORATORIES AND RESEARCH OF THE NEW YORK STATE DEPARTMENT OF HEALTH, by *Augustus B. Wadsworth, M. D., Director.* The Williams & Wilkins Co., Baltimore, 1927

This volume is a complete production containing in detail the procedures of an active, efficient laboratory.

The contents are arranged under general headings, e. g., "General Laboratory Procedures"; "Methods used in the Department for the Preparation of Media and Glassware"; "Methods used in the Antitoxin, Serum, and Vaccine Laboratories," etc. Each general heading is again divided into sections and chapters and each subject is there treated of in detail from the incipiency through the completed product. Under each department the work is so given that the beginner may follow through step by step.

The section on "Methods used in the Executive Offices" deals with the executive side from all angles and is most complete.

This work, although coming from a large institution, will be found a most valuable addition to any laboratory because of the completeness of its subject material and the orderly and detailed presentation thereof.

CLINICAL CASE-TAKING, by *Geo. R. Herrmann, M. D., Ph. D., Assistant Professor of Medicine, Tulane University, New Orleans.* The C. V. Mosby Co., St. Louis, 1927

This little volume is intended to be a supplement to Methods in Medicine, by Dr. George Dock, and will serve a very useful purpose. The slipshod methods frequently followed by internes and busy practicing physicians in case-taking can not possibly produce the best results. The method suggested by Herrmann and carefully described in this book is easily followed and requires a minimum of time for

its execution, yet will result in histories worth having and will go far toward pointing the way to a correct diagnosis.

LIPPINCOTT'S POCKET FORMULARY, by *George E. Rehberger, M. D.* J. B. Lippincott Co., Philadelphia, 1927

An unusually complete pocket manual, containing information of practical value frequently needed by every medical man. It is concise, statements are definite, and nothing is left to the imagination. Especially valuable are such headings as Hygiene, where in 20 lines good hygiene is described. This is very much in contrast to the vague prescriptions so often found, "Attention should be directed to proper hygiene," etc. In four pages the essentials of infant feeding are given. The therapy in syphilis is given definitely by days and courses, yet all is presented in less than five pages. The definiteness of what and how to do will appeal to those who like a place for everything and everything in its place.

The book is intended to complement and supplement one's medical education. In it, information may be more readily found and is more accurate than can be obtained by an appeal to the unaided memory. It can easily be carried in one's pocket.

OVERCOMING TUBERCULOSIS by *Gerald B. Webb, M. D., Consulting Physician, Cragmor, Glockner, Sunnyrest, and the National Methodist Episcopal Sanitoria; Former President, National Tuberculosis Association, etc.*, and *Charles T. Ryder, M. D., Cragmor and Glockner Sanitoria; Colorado Foundation for Research in Tuberculosis; etc.* Third Edition, revised. Paul B. Hoeber (Inc.), New York, 1927

This is the third edition of that valuable little book, "Recovery Record, for Use in Tuberculosis," with a change in title, the purpose of which is to call attention to the fact that recovery of the individual patient should not be the whole aim of treatment. It shows how the patient in fighting for his own recovery may aid in the fight against tuberculosis in general, thus adding another helpful stimulus to his desire to get well.

Like its predecessors, this edition provides a real aid to recovery.

THE CARE OF THE PATIENT, by *Francis Weld Peabody, M. D., Professor of Medicine, Harvard Medical School.* Harvard University Press, Cambridge, 1927

This small book of 48 pages contains much of value. In it the author shows the importance of acquiring the art of practice as well as a knowledge of the science of medicine. Physicians are told to consider their patients as "sick human beings" and not simply as "cases."

Following the advice given will do much to help the young medical man gain the affection, as well as the esteem, of his patients.

Getting Well and Staying Well, by *John Potts, M. D., Fort Worth, Tex.* Introduction by *J. B. McKnight, M. D., Superintendent and Medical Director, Texas State Tuberculosis Sanatorium.* The C. V. Mosby Co., St. Louis, 1927

Another book written for the patient who has tuberculosis, his family and friends, and the doctor who is attending him—and a good one.

The value of an understanding of tuberculosis in its early stages by the doctor is shown to be the most important asset for the patient, as it is the early case that recovers.

Helpful advice is given and the sufferer from tuberculosis will profit from a reading of the book.

The American Illustrated Medical Dictionary, by *W. A. Newman Dorland, A. M., M. D., F. A. C. S., Lieut. Col., M. R. C., U. S. Army; Member of the Committee on Nomenclature and Classification of Diseases of the American Medical Association.* Fourteenth edition. W. B. Saunders Co., Philadelphia, 1927

Although the thirteenth edition of Dorland's Dictionary was published only two years ago, advances in the medical sciences have rendered desirable a new edition at this early date.

In this fourteenth edition, 100 new cuts and over 2,000 new words have been added. E. C. L. Miller, M. D., professor of bacteriology and biochemistry, Medical College of Virginia, has collaborated with Doctor Dorland in producing this thoroughly up to date dictionary.

International Clinics, Volume II, Thirty-seventh Series, 1927, Edited by *Henry W. Cattell, A. M., M. D.* J. B. Lippincott Co., Philadelphia, 1927

This number of International Clinics contains, as usual, much useful information. In it are published, among others, the following papers: Allergic Diseases in Relation to Climate, by W. Storm Van Leeuwen, M. D., of the Royal University of Leiden; A Heart-block Clinic, by L. F. Bishop; Bunion—Its Cause and Cure, by H. A. Robinson, M. D., of Kenosha, Wis.; and Medicine From the Standpoint of History, by John R. Oliver, M. D., Ph. D., of Baltimore.

A medical questionnaire which will serve as a test of the state of one's medical knowledge is also given.

# THE DIVISION OF PREVENTIVE MEDICINE

**Commander M. A. Stuart, Medical Corps, United States Navy, in charge**

## Notes on Preventive Medicine for Medical Officers, United States Navy

### EPIDEMIC OF INFLUENZA AND UNUSUAL PREVALENCE OF OTHER COMMUNICABLE DISEASES AT THE UNITED STATES NAVAL TRAINING STATION, HAMPTON ROADS, VA., DURING THE WINTER AND SPRING OF 1927

As previously reported in the Bulletin, a severe epidemic of influenza occurred at the United States Naval Training Station, Hampton Roads, Va., early in January, 1927. The outbreak continued much longer than was to be expected from experience with that disease in the Navy during and since the World War, and it was accompanied and followed by a greater incidence of scarlet fever, measles, and mumps than was to be expected.

With a view to correcting or obviating conditions making for the introduction and spread of communicable diseases so that such bad health conditions may not be encountered in future years, morbidity statistics were prepared, by direction of the Surgeon General of the Navy, to contrast conditions during the first four months of 1927 at the United States naval training station, Newport, R. I., where the prevalence of communicable diseases was not greater than expected, with conditions existing at the Hampton Roads Station. Each station was then visited, and a study of communicable-disease hazards was made by Commander J. R. Phelps, Medical Corps, United States Navy, representing the Bureau of Medicine and Surgery, and Lieut. Commander Paul Hendren, United States Navy, representing the Bureau of Navigation.

The following memorandum prepared for the Surgeon General of the Navy by the Division of Preventive Medicine shows the incidence of communicable diseases at each station during the period in question and summarizes certain conditions already appreciated:

The following tables, compiled from Form F cards returned by the two stations under consideration, show admissions and admission rates computed on an annual basis, sick days and sick days per 1,000 per annum, by months, during the first four months of this year. In addition, a table is presented to

**show how much greater the admission rates and sick-day rates were at one of the stations than at the other, each month, for certain groups of titles—(*a*) all diseases (injuries and poisoning excluded); (*b*) communicable diseases; and (*c*) other diseases. Sick days include both hospital sick days and sick days on the station:**

***January***

| | Hampton Roads | | Newport | | Hampton Roads | | Newport | |
|---|---|---|---|---|---|---|---|---|
| | Admissions | Rate per 1,000 | Admissions | Rate per 1,000 | Sick days | Sick days per 1,000 | Sick days | Sick days per 1,000 |
| Influenza | 407 | 1,455.74 | 34 | 165.64 | 1,670 | 5,973.17 | 179 | 1,647.24 |
| Catarrhal fever | 142 | 507.90 | 43 | 395.71 | 460 | 1,645.31 | 118 | 1,085.89 |
| Mumps | 124 | 443.52 | 0 | 0 | 1,576 | 5,636.96 | 0 | 0 |
| Scarlet fever | 35 | 125.19 | 0 | 0 | 900 | 3,219.08 | 0 | 0 |
| Tonsillitis, acute | 16 | 57.23 | 9 | 312.88 | 97 | 346.94 | 44 | 404.91 |
| Angina, Vincent's | 10 | 35.77 | 0 | 0 | 96 | 343.37 | 0 | 0 |
| Measles | 6 | 21.46 | 0 | 0 | 41 | 146.65 | 0 | 0 |
| Bronchitis, acute | 2 | 7.15 | 18 | 82.82 | 19 | 67.96 | 153 | 1,407.98 |
| Pneumonia | 1 | 3.58 | 0 | 0 | 113 | 404.17 | 0 | 0 |
| Total | 743 | 2,657.53 | 104 | 957.04 | 4,972 | 17,783.61 | 494 | 4,546.01 |
| All diseases | 845 | 3,022.35 | 140 | 1,288.34 | 9,647 | 34,504.92 | 1,948 | 17,926.38 |
| Per cent of all diseases | 87.93 | | 74.29 | | 51.54 | | 25.35 | |

Hampton Roads: Average strength, 3,355; new recruits, 1,016, or 30.28 per cent.
Newport: Average strength, 1,304; new recruits, 748, or 57.36 per cent.

***February***

| | Hampton Roads | | Newport | | Hampton Roads | | Newport | |
|---|---|---|---|---|---|---|---|---|
| | Admissions | Rate per 1,000 | Admissions | Rate per 1,000 | Sick days | Rate per 1,000 | Sick days | Rate per 1,000 |
| Influenza | 482 | 1,411.42 | 17 | 119.02 | 4,854 | 14,213.76 | 245 | 1,715.29 |
| Catarrhal fever | 115 | 453.88 | 88 | 616.10 | 504 | 1,475.84 | 508 | 3,556.59 |
| Mumps | 73 | 213.76 | 0 | 0 | 1,298 | 3,800.88 | 0 | 0 |
| Measles | 35 | 102.49 | 0 | 0 | 203 | 594.44 | 0 | 0 |
| Pneumonia | 28 | 81.99 | 1 | 7.00 | 1,247 | 3,651.54 | 49 | 343.06 |
| Angina, Vincent's | 20 | 58.57 | 1 | 7.00 | 107 | 313.32 | 5 | 35.01 |
| Tonsillitis, acute | 19 | 55.64 | 26 | 182.03 | 101 | 295.75 | 218 | 1,526.25 |
| Scarlet fever | 9 | 26.35 | 0 | 0 | 216 | 632.50 | 0 | 0 |
| German measles | 2 | 5.86 | 0 | 0 | 24 | 70.28 | 0 | 0 |
| Bronchitis, acute | 1 | 2.93 | 9 | 63.01 | 8 | 23.43 | 61 | 427.07 |
| Chicken pox | 1 | 2.93 | 0 | 0 | 10 | 29.28 | 0 | 0 |
| Pleurisy, fibrinous, acute | 0 | 0 | 2 | 14.00 | 0 | 0 | 6 | 42.01 |
| Total | 785 | 2,298.68 | 144 | 1,008.17 | 8,572 | 25,101.02 | 1,092 | 7,645.27 |
| All diseases | 933 | 2,733.40 | 170 | 1,190.20 | 11,225 | 32,869.69 | 2,197 | 15,381.56 |
| Per cent of all diseases | 84.14 | | 84.71 | | 76.37 | | 49.70 | |

Hampton Roads: Average strength, 4,098; new recruits, 739, or 18.03 per cent.
Newport: Average strength, 1,714; new recruits, 468, or 27.30 per cent.

*March*

| | Hampton Roads | | Newport | | Hampton Roads | | Newport | |
|---|---|---|---|---|---|---|---|---|
| | Admissions | Rate per 1,000 | Admissions | Rate per 1,000 | Sick days | Rate per 1,000 | Sick days | Rate per 1,000 |
| Influenza | 312 | 953. 16 | 3 | 22. 74 | 3, 977 | 12, 149. 70 | 35 | 265. 32 |
| Measles | 102 | 311. 61 | 0 | 0 | 1, 488 | 4, 545. 82 | 0 | 0 |
| Catarrhal fever | 78 | 238. 29 | 57 | 432. 09 | 323 | 986. 76 | 306 | 2, 319. 65 |
| Mumps | 77 | 235. 23 | 0 | 0 | 1, 334 | 4, 075. 36 | 0 | 0 |
| Tonsillitis, acute | 41 | 125. 25 | 31 | 235. 00 | 252 | 769. 86 | 291 | 2, 205. 94 |
| Angina, Vincent's | 29 | 88. 59 | 0 | 0 | 374 | 1, 142. 57 | 0 | 0 |
| Scarlet fever | 25 | 76. 37 | 1 | 7. 58 | 531 | 16, 622. 20 | 42 | 318. 38 |
| Pneumonia | 2 | 6. 11 | 4 | 30. 32 | 304 | 928. 72 | 118 | 894. 50 |
| Pleurisy, fibrinous, acute | 2 | 6. 11 | 0 | 0 | 67 | 204. 68 | 0 | 0 |
| Bronchitis, acute | 1 | 3. 05 | 2 | 15. 16 | 10 | 30. 55 | 10 | 75. 81 |
| Total | 669 | 2, 043. 79 | 98 | 742. 89 | 8, 660 | 26, 456. 22 | 802 | 6, 079. 60 |
| All diseases | 738 | 2, 254. 58 | 135 | 1, 053. 32 | 10, 811 | 33, 027. 49 | 2, 000 | 15, 161. 09 |
| Per cent of all diseases | 90. 65 | | 72. 59 | | 80. 10 | | 40. 10 | |

Hampton Roads: Average strength, 3,928; new recruits, 341, or 8.68 per cent.
Newport: Average strength, 1,583; new recruits, 243, or 15.35 per cent.

*April*

| | Hampton Roads | | Newport | | Hampton Roads | | Newport | |
|---|---|---|---|---|---|---|---|---|
| | Admissions | Rate per 1,000 | Admissions | Rate per 1,000 | Sick days | Rate per 1,000 | Sick days | Rate Per 1,000 |
| Mumps | 198 | 638. 02 | 0 | 0 | 1, 463 | 4, 714. 29 | 0 | 0 |
| Influenza | 135 | 435. 02 | 1 | 8. 42 | 1, 787 | 5, 758. 32 | 50 | 430. 76 |
| Catarrhal fever | 52 | 157. 56 | 12 | 100. 98 | 186 | 599. 36 | 57 | 479. 66 |
| Tonsillitis, acute | 27 | 87. 00 | 27 | 227. 21 | 230 | 741. 14 | 211 | 1, 775. 60 |
| Measles | 25 | 80. 56 | 3 | 25. 25 | 1, 206 | 3, 886. 14 | 69 | 580. 65 |
| Angina, Vincent's | 5 | 16. 11 | 0 | 0 | 233 | 750. 81 | 0 | 0 |
| Scarlet fever | 4 | 12. 89 | 0 | 0 | 89 | 286. 69 | 0 | 0 |
| German measles | 4 | 12. 89 | 0 | 0 | 41 | 132. 12 | 0 | 0 |
| Pneumonia | 2 | 6. 44 | 1 | 8. 42 | 258 | 831. 36 | 45 | 378. 68 |
| Cerebrospinal fever | 0 | 0 | 1 | 8. 42 | 0 | 0 | 49 | 412. 34 |
| Total | 452 | 1, 456. 50 | 45 | 378. 68 | 5, 493 | 17, 700. 32 | 481 | 4, 047. 69 |
| All diseases | 512 | 1, 649. 84 | 78 | 656. 38 | 7, 043 | 22, 694. 95 | 1, 261 | 10, 611. 50 |
| Per cent of all diseases | 88. 28 | | 57. 69 | | 77. 99 | | 38. 14 | |

Hampton Roads: Average strength, 3,724; new recruits, 250, or 6.71 per cent.
Newport: Average strength, 1,426; new recruits, 221, or 15.50 per cent.

***Figures for the naval training station, Hampton Roads, Va., contrasted with those for the naval training station, Newport, R. I.***

| | Admission rate, per cent above or below | Sick day rate, per cent above or below |
|---|---|---|
| *January, 1927* | | |
| Communicable diseases | +177. 68 | +291. 19 |
| Other diseases | +10. 12 | +24. 97 |
| All diseases | +134. 59 | +92. 48 |
| *February, 1927* | | |
| Communicable diseases | +128. 01 | +228. 32 |
| Other diseases | +138. 08 | +0. 42 |
| All diseases | +129. 66 | +113. 70 |
| *March, 1927* | | |
| Communicable diseases | +175. 11 | +335. 16 |
| Other diseases | −24. 96 | −37. 64 |
| All diseases | +114. 05 | +117. 84 |
| *April, 1927* | | |
| Communicable diseases | +284. 63 | +337. 29 |
| Other diseases | −30. 38 | −23. 91 |
| All diseases | +151. 35 | +113. 87 |

The figures for the Hampton Roads Station, of course, show the effect of the epidemic of influenza which has already been referred to in the United States NAVAL MEDICAL BULLETIN and in more than one number of the Monthly Health Index. The case figures for the epidemic of scarlet fever which occurred there concomitantly also appear. It will be noted, too, that mumps and measles gave rise to a good many cases.

Comparatively few cases diagnosed as influenza occurred at the Newport Station, and the numbers of cases reported as catarrhal fever were, perhaps, not much greater than might be expected at that station during the winter. Information collected during the early days of the year indicated that influenza was prevalent in Greater New York and in different parts of Connecticut. The disease may have been introduced from time to time into the Newport Training Station but it seems improbable that so virulent a strain of the virus was introduced as that disseminated by the destroyers *Reuben James* and *Lawrence* which transferred influenza cases to the Naval Hospital, Norfolk, Va.

Mumps and measles appear not to have been introduced into the Newport Station during the winter. One case of scarlet fever was reported in March. No doubt conditions which inevitably arose with the widespread epidemic of influenza at the Hampton Roads Station increased the difficulty of controlling mumps, measles, and scarlet fever. How much seeding of these diseases took place from foci of infection in Norfolk can not be estimated by us. That may have been quite a factor. Sanitary reports indicated that medical department facilities, messing facilities, and in general the number of men comprising the station force were inadequate for properly dealing with the numbers of recruits sent to the station, even before the epidemic of influenza began, and the sanitary report for the month of June indicated that conditions in the mess hall continued unsatisfactory, in as much as more than one sitting was required at each meal because of an insufficient number of cooks. Facilities, even at that late day, were regarded as inadequate for properly sterilizing mess gear between sittings.

The tables presented above show the strength of personnel and the numbers of recruits received at both stations each month. While overcrowding in barracks was not emphasized in reports from the Hampton Roads Station, too few buildings may have been occupied owing to the fact that the station force was short-handed. This point would have to be verified.

It is not possible to judge how much more effectively the situation might have been handled at the Hampton Roads Station, in spite of the difficulties which were, for the station force, unavoidable, with respect chiefly to influenza, mumps, measles, and scarlet fever. From previous experience one would have expected more prompt control of these diseases. On the other hand, only two cases of cerebrospinal fever occurred, and under the circumstances it would not have been surprising if there had been more, in view of the influenza situation. However, influenza was imported directly from New York and not from contact with the local civilian population. The meningococcus carrier situation in the latter and the numbers of carriers among incoming recruits would largely determine the incidence of meningitis.

The communicable-disease record of the Newport Station, during the World War and since, seems to justify the conclusion that a higher degree of mass immunity against common communicable diseases of the respiratory type, including those mentioned above, ordinarily exists among recruits sent to that station than among recruits who go to Hampton Roads for training. In comparing conditions at the two stations during the past winter this should be taken into consideration.

The admission rate from all causes was somewhat lower than usual at Newport during the past winter as shown by the following table, although there was a considerable excess of admissions for communicable diseases. The excess was due chiefly to acute tonsillitis, catarrhal fever, bronchitis, and influenza:

*United States Naval Training Station, Newport, R. I.*

| | Average strength | Admissions, communicable diseases | Annual rate per 1,000 | Admissions, all causes | Annual rate per 1,000 |
|---|---|---|---|---|---|
| 1923 | 1,597 | 7 | 13.15 | 1,148 | 2,156.54 |
| 1924 | 1,396 | 25 | 53.72 | 561 | 1,205.59 |
| 1925 | 1,039 | 20 | 57.75 | 573 | 1,654.48 |
| 1926 | 1,023 | 222 | 651.03 | 414 | 1,214.08 |
| 1927 | 1,507 | 385 | 766.42 | 561 | 1,167.88 |

NOTE.—The figures are for the first 4 months of each year represented.

So far as information available in this office indicates, the material facilities existing at the Newport Station make proper handling of recruits possible and, so far as known, the station force was adequate for the number of recruits received during the past winter. Monthly sanitary reports from the Hampton Roads Station, on the other hand, have indicated that the number of cooks was insufficient and that the personnel of the Medical Department was overtaxed from the beginning of the year.

The record of communicable diseases on the Hampton Roads Station during the first four months of the year would have been bad even under war conditions. Such long continued prevalence of communicable diseases would seem to be unnecessary in time of peace, but without knowledge of all the circumstances, including detailed information regarding such preventive measures as were adopted, and the ability or inability to apply them effectively with the personnel available, and existing material facilities, one can not judge whether the situation could have been handled better than it was locally or whether measurable success in controlling communicable disease was impossible without departmental action to provide sufficient additional personnel properly to care for the large numbers of recruits sent to that station.

Twelve recruits taken sick at the Hampton Roads Station died from influenza; 1 from cerebrospinal fever following influenza; 1 from pneumococcus meningitis following influenza; and 2 from measles; in all, 15 deaths chargeable to communicable diseases. One apprentice seaman died at Newport. The cause of death was influenza. During the winter and spring, while influenza was epidemic, 21 persons belonging to the Navy and Marine Corps succumbed to influenza or its complications. As indicated above, 14 of the 21 who died were recruits under training at the Hampton Roads Station. The case fatality rate there was about 1 per cent. The disease became intensely virulent among recruits. In one case death occurred within a few hours after the initial symptom and in several during the first few days of illness. The disease closely resembled the war-time picture of influenza. Experience was far different elsewhere in the service, and of 697 cases reported by various ships belonging to the Battle Fleet as well as the Scouting Fleet, none was fatal.

The report submitted by the representatives of the bureau concerned, after inspection and study at each station, is as follows:

Pursuant to orders we proceeded first to Newport, R. I., and then to Hampton Roads, Va., where such information was collected as we deemed necessary for

appreciation of the factors making for the introduction and spread of communicable diseases at each of the stations. Such inspections of buildings as were considered necessary for an understanding of conditions affecting health were made at each station.

At the Newport station we were much impressed with the existing spirit of cooperation and teamwork on the part of all officers and chief petty officers dealing with recruits, which is undoubtedly due largely to the personality and the manner in which the commanding officer conducts administration. Captain Todd is a positive factor in promoting the prompt detection of new cases of communicable disease because he considers it very important that every recruit be permitted to go to a dispensary at any time, day or night, if feeling ill, and he insists that boys who appear ill be sent to see a medical officer at once even if they do not desire to do so. The executive officer and the officer who has immediate charge of training activities appear to be thoroughly indoctrinated with these views which they also entertain for themselves. Captain Lackey, who has recently assumed command of the training station at Hampton Roads, also appeared to understand the important effect which the commanding officer can produce by making it clear to all subordinates that he insists upon immediate examination at all times of recruits who are sick or look to be sick. We were assured by appearances and by the statements of various officers that contentment, cooperative efforts, and efficiency prevail on the station.

It should be understood that the prompt detection of each new case of communicable disease, followed by immediate isolation of the patient and such concurrent disinfection as may be indicated, is the most effective of all preventive measures that can be applied at a naval training station under essential service conditions, and, for that matter, practically under all conditions. A twice daily or even a daily inspection of all recruits by a medical officer is impracticable. Apart from the possibility that certain cases already infective for contacts might be missed at times, the interference with training and drill periods puts such a method out of the question, at least for routine application. Reliance must therefore be placed largely upon recruits themselves to report promptly if they feel ill and especially upon company and platoon commanders to detect signs of illness.

In searching for an explanation as to why the incidence of sickness, especially of communicable diseases of the respiratory type, has been so much greater in recent months at the Hampton Roads Station than at the Newport Station, we believe possible differences in mass immunity among recruits trained at the two stations should be taken into consideration. Recruits are sent to the Newport Station from the following recruiting offices: Boston, Providence, New Haven, Springfield, Albany, New York, Brooklyn, Buffalo, Newark, Philadelphia, and Pittsburgh. The main recruiting stations from which the Hampton Roads Training Station receives its recruits are: Baltimore, Richmond, Atlanta, Little Rock, New Orleans, Kansas City, Birmingham, Nashville, Raleigh, Dallas, and Houston. It seems probable that recruits coming from the various areas surrounding the cities comprising the latter list are much more susceptible to such diseases as scarlet fever, mumps, measles, etc., and to acute respiratory infections in general, than the boys who have grown up in and around the cities of the North which are located in more thickly populated areas where the climate is more rigorous and where repeated exposure with consequent development of immunity to the diseases in question is more likely to have occurred. So far as this, the factor of mass immunity, is concerned, it would seem that expectancy for common communicable diseases would almost constantly be greater at the Hampton Roads Station. Hookworn infection and a greater percentage of

recruits from southern districts having various physical conditions likely to predispose to infection, may also enter into the question.

While the principle of segregation of incoming recruits for at least 21 days is followed in part at both stations, at neither is there complete segregation in small groups during the detention period. At the Newport Station, recruits upon arrival are quartered overnight in a well designed and well constructed receiving building under excellent sanitary conditions. About 50 incoming recruits can be received, examined, and outfitted daily without seriously overtaxing medical and supply department facilities. The presence of many flies in the building was noted. The building is not screened. The city of Newport was said to be heavily infested with flies. The practice now is to send recruits from the receiving building to a barrack building, a wooden structure formerly used as a "service club." This contains a dormitory compartment, 40 feet long by 68 feet 9 inches wide and a separate space for messing. The building also contains bathing and toilet facilities. At that station the training unit is the company. Companies are organized to a strength of 104 men. Each new company remains in this building for a varying number of days (five to seven and occasionally longer) depending upon the numbers of recruits arriving at the station daily. When the company has been organized to its full strength of 104 men it is transferred to the incoming detention unit, barracks C, where it remains for a full period of three weeks regardless of the number of days already spent in segregation without liberty or contact with the main body of recruits under training. Certain losses occur from day to day through the elimination of unfit recruits and transfers to hospital on account of sickness, so the company strength may be several less than 104 while in barracks C. The average loss was estimated as 6 per cent. Formerly it was considerably more. The reduction was attributed to a gradual decrease in sickness rates and more prompt detection and elimination of unfit recruits in the early days while a company is being organized. In the detention barracks C and also in the wooden barracks where the company is organized, there is overcrowding to the extent that the floor area is only 38 square feet per recruit in barracks C and only 34 square feet in the forming barracks (service club), whereas the minimum standard advocated by the Bureau of Medicine and Surgery is 50 square feet of floor area per person.

There is a mess hall in barracks C unit, which is a very large building of brick and stone construction having an east, west, and center wing. The kitchen, located in the building adjacent to the mess hall in the east wing, used for recruits in detention, appeared adequate in size. Scullery arrangements were satisfactory. Dip tanks are used for the sterilization of all mess gear. The chief petty officer in charge of sterilizing had recently assumed the responsibility and did not appear to be fully informed of requirements. Mess gear was being washed and sterilized at the time of inspection. The water in tanks was near the boiling point but the operator was merely dipping racks in the hot water for six or eight seconds instead of the prescribed one minute in water actually boiling. A log is kept in which entries regarding the temperature of the water in each tank, and the time of exposure, are made after each meal.

Food is sent from this galley to the men of the forming company in the service club building and the mess gear of that company is sterilized here (barracks C). Food is also sent from building C to recruits in the receiving building and their mess gear is likewise sterilized in barracks C.

The west wing of barracks C is occupied by men who have returned from 10 or more days of leave granted them after they have completed the training

period of eight weeks. They are the available-for-transfer men and are allowed daily liberty or watch and watch liberty, in which case an individual is granted liberty every other day. While in one wing of the same building as that in which companies undergoing three weeks' detention are quartered there was said to be no contact whatever with them. The available-for-transfer men receive their food from another galley and they eat in a different mess hall.

There are, near the receiving building, five small buildings which form a group known as barracks A. These are constructed of concrete and bricks. Four were built in 1906 and the fifth in 1909. They are two stories high and all have the same dimensions. These buildings appeared to us to be in good condition, but they were regarded by the commanding officer and senior medical officer as unsuitable for use at present. A number of objections were stated and these are mentioned below. We believe that with adequate supervision, recruits, if not overcrowded in them, could be more safely housed, with respect to communicable disease hazards, than in the comparatively large company groups of 100 or more recruits to a dormitory, as in barracks C of the service-club building. However, the buildings were considered a menace to health by the commanding officer, executive officer, and medical officer, and they were abandoned in February, 1927. Since then, recruits have been handled as outlined above. The following reasons were given for making the change: Shortage of personnel was stated to make it necessary at that station to place not less than a company unit of 104 men under the supervision of one chief petty officer, a company commander. It was also stated as necessary that not less than 26 men (a fourth of a company) be quartered in each barracks A dormitory. Using both stories, and putting 26 recruits into each dormitory, a company could be put in each building, but if this were done the dormitories would be grossly overcrowded in comparison with the standard of 50 square feet of floor area regarded by the Bureau of Medicine and Surgery as the least that can be considered conducive to proper hygienic and sanitary conditions in barracks. If recruits quartered in these buildings were fed elsewhere, and the various messing compartments were also used as dormitories, each building could accommodate 48 recruits on the ground floor, in accordance with the standard of 50 square feet per hammock, but this would not be desirable because there would be insufficient free space for occupants in the daytime. With upper and lower stories used, each building would accommodate 52 recruits, 13 to a dormitory, without serious overcrowding and without swinging hammocks in the compartments hitherto used for messing, which means only two and one-half companies for all five buildings.

Although food has been distributed to recruits at the United States Naval Training Station, Great Lakes, Ill., from a distant kitchen, by means of nested food containers, and served in the messing compartments of similar small barracks without very objectionable results, the mess gear being washed, sterilized, and kept in the barracks, it is at least debatable whether it is not preferable under all conditions for recruits to mess in a mess hall which is separated altogether from living and sleeping quarters and toilets and bathing spaces. At Newport, in barracks A, the mess compartment is separated from the sleeping compartment by a wall which has an open archway, larger than a double door, so there is practically one large space. The mess compartment adjoins the wash room and water-closet compartments. It was found impossible to keep the floors clean. The recruits necessarily had to receive and serve their own food, clean up the tables and floor, and wash their mess gear.

It is probably impossible without a trained man assigned to each building (and that is not practicable) to expect the as yet untrained and undisciplined recruits to keep the building in a sanitary condition. Food was dropped on the floor and tracked over into the sleeping compartment. The recruits would spit on the floor, skylark, and lie on the floor. The floors are old and some of the cracks between boards are quite wide. Food was retained in the cracks. To get the floors clean it was necessary to scrub them daily with soap and water. Cresol solution was used once a week. The floors dried slowly and were often damp. In cold weather it was necessary to keep the windows open for hours to dry the floors. The quarters were then damp and cold. This condition was regarded as a distinct hazard to health. It is considered on the station that the handling of food and cleaning of mess gear can be supervised better for units of 104 men. In the service club building, where the entire new company is quartered in one dormitory while it is being organized, all members can be observed better by the company commander. While the barracks A buildings were being used there were two or three instances of perverted sex practices. The executive officer considers that such occurrences are not likely with the company quartered in a single dormitory where better supervision is possible. While this matter is of secondary importance and is not regarded by the commanding officer or by us as sufficient reason for changing administrative methods designed to prevent the spread of communicable diseases, it was mentioned as an additional reason for preferring present arrangements.

With the "ship's company" at its present authorized strength it was considered impossible to secure adequate supervision of recruits housed in the small barracks. Split up as they were in groups of 26, the senior medical officer stated there was an obvious lack of cheerfulness in the small barracks, which were regarded by him and by recruits as dungeonlike. The buildings are referred to as "cubby holes" by officers attached to the station. In cold weather, it was reported, the buildings could not be kept warm and at even temperature, whereas the larger barracks can be. The medical officer stated that it was difficult to keep the recruits contented in these barracks. They looked forward to transfer, considering detention there as a period of imprisonment. He has seen no signs of discontent since the service club building has been used for organizing companies. Another point was that with the multiplicity of toilets and wash rooms, leaks and other conditions requiring repairs to plumbing, placed an additional burden on the small number of men at the station available for such work.

The commanding officer as well as the senior medical officer believes in the principle of quartering recruits in small groups, but a mess hall separate from dormitories is preferred. We concur in this opinion. It should be possible in a mess hall of adequate size to mess the men in groups of 26 if that is the way in which they are grouped in dormitories. In seating a section or division of 26 recruits at table, half should be seated on one side and half on the other so that the recruits sprayed with each other's mouth secretions in talking, laughing, etc., will belong to the same group and not to another unit. While it may not be possible to prevent contact altogether in the mess hall between members of different companies, practically, segregation to a degree that will greatly minimize the transfer of infectious mouth and nose secretions can be maintained by proper supervision, forming the recruits in different lines to enter, separating tables by short aisles, assignment to

tables, etc. During an outbreak of disease, additional precautions can be taken in the way of setting off a portion of the mess hall for the use of a quarantined company or platoon which may be served at the tables instead of allowing the men to pass by steam tables where the cafeteria system is used.

We learned from the measurements of barracks A building that with 26 men sleeping in the dormitory compartment, the floor area was only 22 square feet per recruit. Serious overcrowding therefore existed in sleeping quarters and this in itself can be regarded as a weighty reason either for abandoning barracks A or utilizing the messing compartment as a dormitory and feeding the men elsewhere, or using more dormitories for each company. Neither alternative, probably, is practicable with the present system of training. The plan of housing now in effect is probably preferable, and one should not overlook the fact that, for various reasons, communicable diseases are not and have not been prevalent on the station, although virulent influenza was introduced in January and February, and scarlet fever also. Undoubtedly there were meningococcus carriers on the station. A few cases developed in August, 1926. There has been a gradual reduction in the incidence of disease since January 1, 1927, and the senior medical officer attributed this in part to abandonment of unit A but he also stated that the decline in admission rates began before the service club building was adapted to house the forming company. The evidence that a strain of influenza virus capable of causing an epidemic was present on the station in January or February is that a recruit took the disease in acute fulminating form and rapidly developed pneumonia with cyanosis and other manifestations so frequently encountered during the pandemic of 1918. Comparatively little spread occurred on the station last winter and spring. There was not a definite spreading outbreak at any time.

After the full 21-day period of detention is completed in unit C, each company is transferred to a dormitory in barracks B unit, where the recruits are quartered for the remaining weeks of the eight weeks' course of training. Another mess hall is used and there is no contact with men undergoing detention, either indoors or out-of-doors. There is overcrowding in barracks B dormitories. Blue prints indicated between 30 and 35 square feet of floor area per recruit in the different dormitories. Recruits quartered in barracks B are granted liberty from 1 p. m. to 11 p. m. Saturdays, Sundays, and holidays. It is said that through the cooperation of transportation companies and the police department, recruits are not transported out of Newport. They wear a uniform combination distinctive from that worn by other bluejackets on liberty.

In general, probably the danger that recruits will come into contact with foci of communicable disease while on liberty is much less than in the case of recruits granted liberty at the Hampton Roads Station. Norfolk is a fairly large city and much transportation of travelers goes on between it and southern communities as well as large cities of the North. It is also a large seaport and shipping center. In the city the recruits probably find greater opportunity for effective exposure to diseases of the respiratory type. The incidence of venereal disease is much greater among recruits granted liberty in Norfolk. While the number of cases of venereal disease recorded for the Newport recruits seems incredibly small to the medical officers attached to the Hampton Roads Station, the actual number of infections is doubtless small due to the environmental conditions.

At the Newport training station the immediate detection of communicable disease is made likely by the comparatively small area of the station, which

makes concentration of the medical department possible, and by the attitude of the commanding officer, who is very insistent that any recruit may see a medical officer at any time, day or night, especially recruits in the incoming detention units. Typhoid prophylaxis is administered under the personal supervision of a medical officer every Tuesday. Hospital Corps men are not permitted to prescribe any medicine for recruits. In view of the known attitude of the commanding officer, company commanders send recruits to the dispensary if they appear to be ill, even if they do not wish to go. The senior medical officer stated that if recognizable manifestations of a sporadic case of a communicable disease appeared during the night and the patient was not isolated before morning, he would consider that something had gone wrong with the system. The recruit should have told his company commander that he was sick and he should have been sent to the dispensary. A medical officer sleeps in the dispensary. The rule is for him to see any acute case of any patient with fever, skin eruption, etc., at once. A suspicious case would be isolated immediately in a closed cubicle in the dispensary. The senior medical officer would see the case in the morning. In diagnosed cases the names of chums and other possible contacts are taken. The patient is transferred to hospital immediately and contacts are inspected once or twice daily depending upon circumstances. Company commanders are informed as to the mode of onset of the disease in question in order that they may be on the lookout for the earliest symptoms if another case should occur. With the appearance of any communicable disease, the company is not permitted to have contact with any other company. It is routine at the dispensary to take a blood count in all fever cases unless the symptoms are mild and suggestive of catarrhal fever or some non-communicable disease.

We judged from appearances and the record of low morbidity rates at the station that the medical department was very effectively administered, even granting a lower expectancy of infectious diseases than at the Hampton Roads Station on account of biological factors referred to elsewhere. The comparatively small area of the station, location of barracks buildings, and short distance to the naval hospital contribute to make possible the concentration and economical employment of medical department personnel.

The senior medical officer stated that shortage of Hospital Corps men had been a handicap, and that he had been without the services of a chief pharmacist's mate for six weeks. He pointed out that the authorized complement of Hospital Corps men was 19 and the average number available for duty had been 11. According to the records of the Bureau of Navigation, the status of enlisted personnel of the Hospital Corps branch at the station, September 2, 1927—the day of inspection—was as follows:

| | Allowed | On board | Excess | Vacancies | Replacements required |
|---|---|---|---|---|---|
| Chief pharmacist's mate | 2 | 0 | ---------- | 2 | 2 |
| Pharmacist's mate, first class | 2 | 2 | ---------- | ---------- | ---------- |
| Pharmacist's mate, second class | 4 | 4 | ---------- | ---------- | ---------- |
| Pharmacist's mate, third class | 6 | 5 | ---------- | 1 | 1 |
| Hospital apprentice, first class | 4 | 2 | ---------- | 2 | 2 |
| Hospital apprentice, second class | 1 | 0 | ---------- | 1 | 1 |

**The status of enlisted personnel of the Hospital Corps branch at the United States Naval Training Station, Hampton Roads, Va., September 6, 1927—the day conditions were studied there—was as follows:**

| | Allowed | On board | Excess | Vacancies | Replacements required |
|---|---|---|---|---|---|
| Chief pharmacist's mate | 3 | 3 | | | |
| Pharmacist's mate, first class | 6 | 8 | 2 | | |
| Pharmacist's mate, second class | 6 | 11 | 5 | | |
| Pharmacist's mate, third class | 9 | 3 | | 6 | |
| Hospital apprentice, first class | 9 | 3 | | 6 | 6 |
| Hospital apprentice, second class | 5 | 0 | | 5 | 5 |

The senior medical officer of the Hampton Roads Station stated that the number on board was 27. He said three chief pharmacist's mates were allowed and there were but two available, the discrepancy being due to the fact that one (Grisette) is a district chief pharmacist's mate, who performs no duty for the training station.

We believe it is very important that the complement be kept filled constantly at the Hampton Roads Station. A larger authorized strength of Hospital Corps men than at the Newport Station is required, not only because of greater number of recruits at the Hampton Roads Station but because of additional activities not carried on at the Newport Station. Furthermore, the large area of the station, location of barracks, and the apparent necessity for operating three dispensaries interfere with the concentration and economical use of medical department personnel. The work of the medical department would be much less efficient due to time wasted in getting about the station were it not that privately owned automobiles are constantly used on Government business.

Unit D originally planned and built for the purpose is used for incoming recruits. They live in the small barracks of that unit during their first three weeks on the station. The grounds and buildings were clean and attractive and reflected excellent maintenance. No recruit remains in this detention unit for less than three weeks. Sanitary conditions were very satisfactory and barracks were not overcrowded, there being not less than 500 cubic feet of space and not less than 50 square feet of floor area per recruit in every occupied dormitory. The capacity of the detention unit is 720. At the present rate at which recruiting is conducted there might possibly be 8 or 10 platoons in detention. Motion pictures are shown in the unit every night so that contact between members of different platoons is possible.

Sick call is held in the dispensary belonging to the unit and a Hospital Corps man is on watch in that dispensary at all times, day and night. The routine is for the Hospital Corps man on duty to see any recruit who reports sick or is sent to the dispensary by his platoon commander or chief petty officer standing duty in the office at the entrance to the unit. Hospital Corps men are instructed not to prescribe any medicine for recruits. The recruit's temperature is taken and the medical officer on duty in the dispensary in unit A (formerly the naval hospital, naval operating base) is notified by telephone. The latter dispensary may perhaps be designated here as the administrative dispensary. If it appears that the patient should be seen by the medical officer, an ambulance is sent and the recruit is brought to the unit A dispensary where he is put to bed if a communicable disease is suspected or if symptoms otherwise require. Should it be deemed advisable to

transfer him to hospital, further transportation by ambulance to a pier at the operating base is necessary. The patient is then transferred to an ambulance boat which takes him to the dock of the naval hospital, Norfolk, Va. If a blood count is required, the station laboratory is notified. That is located at a considerable distance from both the unit D dispensary and from the administrative dispensary. The medical officer stated that blood counts and all other laboratory procedures indicated were promptly executed but one can not escape the impression that the distances involved are not conducive to immediate examination of blood in cases where the necessity for the same is not quite obvious. The need for a dispensary in unit D is, of course, apparent, and with the existing personnel situation and the numbers of recruits now under training it is impracticable to assign a medical officer to night duty there. The situation in this respect is not different from that at the Newport Station.

At the Hampton Roads Station the drill or training unit is the platoon consisting of 56 recruits. This requires more chief petty officers than at the Newport Station where the company of 104 is the unit. This is desirable in that more personal attention is at least theoretically possible. With the men quartered in a number of small barracks, as they are, it would be quite difficult to secure proper supervision of 104 recruits formed into a company under the command of one chief petty officer. Housing conditions in unit D and, in general, in other units on the station could be considered as much superior to those existing on the Newport Station if it were not for the fact that there are no verandas and no covered spaces available for forming platoons. Recruits must step directly out of all barracks buildings to a sidewalk or road. They must walk or march comparatively great distances to the mess hall or drill hall. In wet weather it is practically impossible to avoid much wetting of shoes and clothing. In general, recruits are careless and irresponsible and it is difficult or impossible to prevent them from getting wet. It is understood that the present commanding officer is proceeding energetically to see to it that all recruits are provided with rain clothes and is making an effort to prevent them from getting their feet wet and from sitting around in wet clothing. On any rainy day, probably hundreds of recruits get wet to a greater or less degree. This was probably a potent predisposing cause of colds and other acute infections of the respiratory type during the past winter and spring.

When all members have completed 21 days in the detention unit D, the platoon is transferred to barracks in unit B, where it is quartered during the remaining five of the eight weeks' training period. Each barracks building here accommodates half a platoon, or 28 recruits. Sanitary conditions, except for the lack of varandas, were found to be excellent as in unit D. There was no overcrowding and in all sleeping rooms the space averaged more than 500 cubic feet and the floor area more than 50 square feet per recruit.

Unit B recruits are granted liberty as follows: Wednesday, 4:30 p. m. to midnight; Saturday, 1 p. m. to midnight; and Sunday, from 11 a. m. to 5 p. m. One platoon, designated the honor platoon, is granted liberty from 1 p. m. Saturday to midnight Sunday.

A very important factor making for the spread of communicable disease on the station is the messing situation. All enlisted men attached to the station, recruits and rated men as well, are fed in one mess hall. September 3, 2,739 persons were fed there, and the number has been as great as 3,200. The comfortable seating capacity is 2,000. The crowded maximum capacity is about 2,400. The cafeteria system is used. There are eight entrances, and

steam tables and food serving tables are arranged so that eight different lines of men can receive food simultaneously. Only 14 minutes is required to serve 2,000 men. Two sittings are required at each meal. Some time is allowed after the first sitting before men of the second sitting are admitted. Until two months ago the same mess gear was used for both sittings. It was washed, and an effort was made to sterilize it, but the senior medical officer reported at various times that proper sterilization was not secured. The present commanding officer has devoted much thought and effort to improving conditions. Enough mess gear in good condition is now on hand for all who eat in the mess hall, and the gear used at the first sitting is thoroughly cleaned and sterilized deliberately, after which it is stored in a sanitary manner until the next meal, no article being required for the second sitting at the same meal. One hazard, that existing because of the haste required in getting ready for the second sitting, has thus been overcome. There is ample space for washing and sterilizing. Nine dip tanks filled with boiling water are arranged in a row along one side of the buildings. Each rack of mess gear is transferred from one to another until it has been through all. The time varies, but it is said that every rack is exposed in water at, or not much below, the boiling temperature for at least two minutes. It appears that the mess gear is now and has been receiving adequate sanitary care for about two months. Strict watch is kept on mess cooks and kitchen force for signs of illness. In case of sickness they are sent immediately to the dispensary in unit J.

With reference to the midday meal, which will serve as an example of the method of feeding, at 10.30 a. m., 148 mess cooks eat. At 11 a. m., about 1,000 recruits from unit D (recruits undergoing detention) are marched to the mess hall and admitted. At the same time, from 350 to 400 watch-standers and members of the bluejacket guard from unit J eat. These are largely men who have just completed the eight weeks' training period and are awaiting transfer to ships. Many of them have recently returned from several days' leave and all enjoy overnight liberty, which is granted daily by watches, day on and day off.

Although the detention unit recruits are kept together while marching from unit D to the mess hall, with the cafeteria system it is not considered practicable to prevent contact altogether with other men, and, as they finish eating and leave the tables at different times, there is no real segregation. Contacts in the mess hall and outside after eating may thus be responsible for much spread of communicable disease. Although unit D is well adapted to the purpose of maintaining the principle of strict segregation of incoming recruits from all others, for a period of three weeks, and, when necessary, further segregation or quarantine in small groups, practically the system is not in effect, because all recruits are marched from the detention unit three times a day to the mess hall and members of af all platoons may mingle and contact can not be prevented with men who may be developing communicable disease as a result of exposure in Norfolk and other near-by communities or in distant cities recently visited while on leave.

We agree with the commanding officer and the senior medical officer that it is a matter of the utmost importance in the interests of controlling the spread of communicable diseases that the mess hall in unit D be put in operation immediately. If opened, that mess hall would take care of all recruits in the detention unit. Its capacity is 800. The hall is in two distinct parts and was planned for the purpose of keeping companies of recruits fairly well segregated at meals. By the exercise of some little care, segregation to an effective degree

could even be maintained by platoons. This could be secured by making short aisles between tables and seating each half of a platoon facing the other half.

Similar attempts to preserve segregation could then be made in the other mess hall, which is large enough for the remainder of the personnel.

Although an insufficient number of cooks and bakers has been reported as the reason why the unit D mess hall has not been opened before this, the present commanding officer considers that he can put the building in commission with the personnel now allowed if he can raise approximately $700 required to make certain necessary repairs. He thinks he should recover about that amount from charges against the training station allotment regarded as improperly made.

We recommend that the Navy Department take such action as may be necessary to make the immediate opening of the mess hall practicable. The crux of the matter is that failure to keep recruits properly segregated is due to the use of but one mess hall, and success in preventing the spread of communicable disease on the station after it has been introduced from sources without very largely depends upon proper segregation.

Seven hundred dollars seems a small sum to stand in the way of so important a measure affecting health and the prevention and control of communicable disease. Our attention was invited to the extensive area of the station and the great number of buildings requiring the expenditure of money and much labor for upkeep. It was stated that the cost of heating all structures on the entire operating base is apportioned according to numbers of personnel comprising the different activities, and that about 87 per cent of the cost of heating is charged against the naval training station allotment. This is considered very unfair by the officers attached to the training station because other activities have a great deal of radiator area and large spaces to heat. Moreover, there is a great loss of heat units in the exposed overhead steam lines through which steam is sent to all parts of the base. In general, the training station buildings are rather close to the power plant, whereas some of the other activities are located at comparatively great distances and the loss of heat in passage to them is relatively great. This, under the present arrangement, is also a tax on training-station resources.

With so many wooden buildings having large numbers of windows the replacement of glass broken by recruits in play, skylarking, etc., is a considerable item. About $800 must shortly be spent for window glass. With so many separate bathing and toilet installations, upkeep is expensive. Even keeping the grounds in their present excellent condition is costly in labor. It is our impression from what we saw and heard that the cost of maintenance per recruit trained would necessarily be greater than at a more compactly laid out station. It should be remarked that units not in use showed evidence of much work in the way of upkeep. The grounds were well cared for. The mess hall of unit D which has not been used for a long time was clean throughout, the ranges and other equipment in the kitchen were polished, and bright work was well shined.

Unit K, east, houses the men attending the various schools, and unit K, west, is used for the receiving ship unit. Ship's company men, as well as recruits who have completed duty and are available for transfer, are quartered in unit J.

The station has experienced a good deal of difficulty in clearing recruits after the training period is over. Such men are quartered in unit J. With large numbers remaining at the station they are a factor in spreading disease imported from nearby or distant communities. The station includes unit J men in reports showing strength of personnel, whereas there are seldom many

available for transfer men at the Newport Station. No difficulty about clearing recruits was mentioned there. On the contrary, the executive officer stated that he foresaw difficulty in getting enough men to fire boilers for the adequate heating of the training station buildings next winter because they were unable to retain men for duty.

At the Hampton Roads Station, the dispensary in which sick call is held for recruits other than those in detention, for the personnel attending trade schools, for the available-for-transfer men, and for the ship's company, is located in unit J. Patients who require transfer to hospital, or closer observation than it is practicable to provide in that dispensary, are removed to the administrative dispensary in unit A, as is done in the case of recruits admitted to the unit D dispensary. A change in practice does not seem possible, but it may be noted that more effective concentration of medical officers and Hospital Corps men could be secured if a suitable building, something like that housing the main dispensary at the Newport Station, were available in a central location where sick call could be held for all persons other than recruits in detention and where the administrative offices could be located.

The senior medical officer of the Hampton Roads Station is also aid to the commandant of the naval district, and he has general supervision over medical department activities other than those of the training station, and sanitary work for the entire naval operating base is directed by him through a medical officer who acts as sanitation officer. This is a large and important activity. The malaria-control work alone is of considerable magnitude. The sanitation officer is also in charge of the laboratory which serves the entire station. The senior medical officer is responsible for about $200,000 worth of medical and surgical supplies and property stored in a brick building near unit A. The full-time services of two Hospital Corps men are required for the issue of supplies to all medical department activities on the base and for proper care and accounting.

September 6, the day we visited the station, there were 1,051 men under training in schools. This is an activity not found at the Newport Station. The total number of men under training at Hampton Roads September 6 was 3,004.

We were fortunate in meeting Capt. R. C. Holcomb, Medical Corps, United States Navy, who is district medical officer as well as commanding officer of the naval hospital at Norfolk. He visits the station regularly every Tuesday and has been closely in touch with the situation there throughout the winter and spring. We discussed epidemiological matters with him. He said he wished to indorse thoroughly all the station has done and is trying to do. He believes the officers there deserve commendation. We believe the medical officers attached to the station have necessarily worked very hard since January 1, 1927, and even before that date.

We would sum up the reasons that seem to us to explain the unusually great incidence of communicable diseases on the station every month since the first of the year as follows:

(1) A sudden increase in the numbers of recruits sent to the station about January 1 caused a relative shortage of personnel, especially in the commissary department and medical department.

(2) The susceptibility of recruits drawn from recruiting offices which supply the station is comparatively great so far as diseases of childhood and acute infectious diseases of the respiratory type in general are concerned.

(3) Influenza of epidemic type and quite virulent in form was introduced about January 7. The disease spread rapidly as it usually does everywhere

during outbreaks. Conditions on the stations were especially favorable to its spread. The epidemic strain of influenza virus was very likely introduced from New York City by the crews of the U. S. S. *Lawrence* and U. S. S. *Reuben James*. Epidemics began on board both of those vessels about 48 hours after they left New York for Cuba. They put into Norfolk on January 7, spent about one hour at the navy yard without contact between their crews and persons ashore, while arrangements were being made for medical care. Both vessels then proceeded down river and tied up at the dock of the naval hospital in Portsmouth. As the commanding officer of the hospital put it, he had two sick destroyers on his hands. Most of the men attached were acutely ill. Here then was opportunity, by spread from the hospital, for the thorough seeding of virulent influenza not only in the training station but among all organizations at the operating base and in Norfolk. The disease became epidemic in the cities of Norfolk and Portsmouth at about the same time. In view of the fact that several days usually elapse before it can be determined that influenza is epidemic in a city population group, it is possible that the disease was introduced into Norfolk earlier by civilian travelers from New York or other place where an epidemic was occurring. The important point is that the disease became epidemic in Norfolk.

(4) Recruits, furnishing a constant supply of fresh susceptible material, continued to arrive in large numbers. Apart from the question whether the virulence of the causative agent increases with rapid spread of the disease, experiments with colonies of white rats, as conducted by Topley, and by investigators at the Rockefeller Institute in this country, suggest that the introduction of fresh susceptibles is a factor of the greatest importance in sustaining and lengthening an epidemic and increasing the mass dosage to which later victims are exposed, as well as the severity of individual cases. Recurrent epidemics also are likely to occur under such conditions, during which, individuals who have previously escaped not infrequently become infected, as well as newcomers.

(5) Due to the increased numbers of recruits under training, and in addition the large number of men attending the various schools, and inability to clear the station rapidly of available-for-transfer men, as well as the great area of the station, medical department personnel was overtaxed.

(6) Inasmuch as all enlisted men were fed in a single mess hall there was not effective segregation of infected platoons in any unit, and recruits from the detention unit came into contact with men from all other units, or they almost constantly had opportunity to do so. Contaminated mess gear, used for second sittings without adequate exposure to boiling water, was very likely another factor in spreading disease.

(7) Under the conditions existing, it seems probable, with large numbers of recruits sickening from day to day, that platoon commanders would instinctively tend to keep as many of their recruits in ranks as possible, and that boys who did not appear very ill would not be sent to a dispensary. Thus, there would be serious interference with the prompt detection of such diseases as mumps, measles, and scarlet fever, and the spread of influenza would be favored.

(8) Influenza was also epidemic in the city of Norfolk, and, as indicated by bulletins issued by the city health department, cases of mumps, measles, and scarlet fever were being reported. These diseases were doubtless introduced from time to time by men infected while on liberty.

(9) Reports from Southern States indicate that epidemics of influenza occurred later in the spring, and influenza virus of an epidemic strain was probably introduced from time to time by incoming recruits. The arrival of susceptibles, some of whom had already been effectively exposed, appears to

have been an additional factor making for long continuation of the influenza epidemic. With contact between recruits in detention and the men of other units, there was opportunity for the periodic reseeding of the virus in all parts of the station.

(10) Inclement weather and the wetting of recruits on rainy days was undoubtedly a serious matter. Such a predisposing influence, leading to the development of colds, along with the other epidemiological factors, would favor the spread of communicable diseases by making it more difficult to secure prompt detection and isolation. In many cases it was difficult to decide whether a sick recruit had a cold, was suffering from the effects of typhoid vaccine, had influenza, or was developing measles.

We believe the Hampton Roads Station will have a greater expectancy of communicable diseases every year than the Newport Station, but we consider that conditions were very unusual during the first six months of 1927 and that a similar situation is not likely to recur. An epidemic of influenza could not have been avoided, but it is not likely that it would have continued for several months or that scarlet fever would have continued on the station in epidemic proportions as long as it did if a separate mess hall had been in use for recruits in the detention unit, if recruits had been segregated to the degree that existing facilities permit, and if platoon commanders had been thoroughly imbued with the idea that the prompt detection of communicable diseases depends largely upon their observation of recruits and their action to insure immediate examination by a medical officer.

The senior medical officer believes that important information of assistance to the station in planning measures of prevention and control of disease would be had if copies of Bureau of Navigation letters of information to recruiting officers were sent to each of the training stations concerned.

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## A CASE OF HEMORRHAGIC ENCEPHALITIS, NEOARSPHENAMINE POISONING, WITH RECOVERY

By P. F. Dickens, Lieutenant, Medical Corps, United States Navy

The patient in this case was admitted to the United States naval hospital, Parris Island, S. C., about 8.30 a. m., June 17, 1927, in a comatose condition. He was a general court-martial prisoner, 22 years of age, who had been in the United States naval service for one year.

The only history available at the time of admission was that he had been found having a convulsion in the grounds of the prison about 15 minutes before. When found he was thought to have epilepsy. When seen by the writer a few minutes after admission he was very cyanotic, deeply comatose, and was having convulsions at intervals of about three minutes, lasting one or two minutes, affecting the muscles of the neck, face, upper extremities, and muscles of respiration. After a series of clonic movements, the muscles became fixed in tonic contractions at the height of each convulsion, and this state was followed by clonic contractions lasting for a few seconds until the interval when the muscles were apparently at rest. During the intervals, however, a meningeal type of respiration was observed—the

so-called Biot's type. The leg muscles were flaccid and appeared to be paralyzed.

Clearly, epilepsy could not account for this condition. Information was sought by telephone. A Hospital Corps man who answered the telephone at the prison stated the patient was under treatment for syphilis and had been given two doses of neoarsphenamine intravenously, by syringe; the first, 0.9 gram, 10 days previously, and the second, 0.9 gram, 66 hours before admission to hospital. Later, it was learned that he had had a chancroid infection about four and a half months before, while an apprentice seaman under training at the United States naval training station, Hampton Roads, Va. About five weeks before he was found unconscious, he complained of sore throat, headache, and pains in the arms and legs, especially at night. Treatment for syphilis was begun at that time. His health record indicates that he received protoiodide of mercury by mouth, beginning with one-sixth of a grain, increasing to two-thirds of a grain three times a day. After three weeks' treatment, mercury was discontinued on account of salivation. Four days later, a strongly positive Kahn test having been obtained, treatment with mercury was resumed and one-third of a grain of protoiodide was given three times a day until the day before he was brought to hospital.

With the knowledge gained by telephoning, that the patient had been under treatment for syphilis, he was carefully examined with the idea that his condition might be due to acute poisoning by neoarsphenamine. Both pupils were contracted to pinhead size. Neither direct nor consensual reflexes were abolished. There was no evidence of head injury. The pulse was full, bounding, and regular. The systolic blood pressure was 170 and the diastolic, 85. The cerebrospinal fluid was found to be under increased pressure—42 millimeters of mercury. The fluid was clear, contained 150 milligrams of sugar per 100 cubic centimeters, and gave a cell count of 135 per cubic millimeter. A Kahn test with the fluid was negative.

The patient was catheterized and 100 cubic centimeters of urine were withdrawn. The urine contained a large trace of albumin and numerous granular casts, with red and white blood cells.

Chemical examination of the blood showed 245 milligrams of sugar per 100 cubic centimeters of blood.

Shortly after he was admitted to the hospital ward, the patient was etherized to control convulsions and 300 cubic centimeters of blood were withdrawn from a vein. He was kept under the influence of ether for about an hour. Convulsions began as soon as the use of ether was discontinued and about 10 minutes later respiration ceased. Manual artificial respiration was begun and continued for 30 minutes when respiration of the Cheyne-Stokes type was observed.

It was at this point that lumbar puncture was performed with the hope that withdrawal of cerebrospinal fluid would, by reduction of intracranial pressure, improve the breathing.

By this time a solution of sodium thiosulphate was ready for intravenous injection and 2.5 grams were injected. This was just four hours after the patient was brought to hospital. Ampules of chemically pure sodium thiosulphate, although in stock at the hospital, could not be found immediately, so a quantity of sodium hyposulphate was taken from the photographic supplies, washed, and recrystallized. No apparent harm resulting, this was used for all doses, although six ampules of sodium thiosulphate were found later in the day. Seven and a half hours after the first dose, 1.5 grams were administered intravenously, and four hours later 1.5 grams were injected.

About five hours after the first dose the swallowing reflex returned, and convulsions had ceased, but the patient continued to show indications of considerable cerebral irritation. He remained cyanotic and respiration showed no improvement. Projectile vomiting occurred at this time but was not repeated. With a view to alkalinizing the tissues, sodium bicarbonate was given by mouth as soon as the swallowing reflex returned, 2 cubic centimeters of a 10 per cent solution every five minutes for about 12 hours. During the same period a 10 per cent solution of sodium bicarbonate was also given by proctoclysis.

No further improvement in the patient's condition was noted until about an hour after the third dose of sodium thiosulphate was administered. Copious perspiration, involuntary evacuation of feces, and incontinence of urine were then noted. Respiration also approached normal.

Twenty-four hours after the patient was admitted to hospital he was still in a state of coma, but about that time his temperature rose to 101.8° F. and the pulse rate was between 120 and 130. Respirations were 24 to 32.

The fourth dose of sodium thiosulphate, 0.5 gram, was injected 14 hours after the third, or 32 hours after admission to hospital. At that time the urine continued to show albumin, casts, and red and white blood cells.

Forty-one hours after admission the patient showed the first sign of returning consciousness by asking, "Where am I?"

The fifth dose of sodium thiosulphate, 1.5 grams, was administered intravenously 48 hours after admission. At that time the pupils were equal and reacted to light and in accommodation. The patient complained of a severe headache. He was not entirely oriented. He looked staringly at objects, turned his head from side to side, and had

fine tremors of the facial muscles. His tongue was swollen, but that was due to the use of tongue forceps, which had been used for a few minutes before a suture was passed.

The patient continued to improve. Seventy-two hours after admission he was oriented and his headache had disappeared. His urine had cleared up to a certain extent, but it still contained a trace of albumin and a few casts. Largely because of the signs of kidney involvement, intravenous administration of sodium thiosulphate was continued. The sixth dose, consisting of 1.5 grams, was given 72 hours after admission, and the seventh and last dose was injected 96 hours after admission. The last was given more as a matter of precaution than for any other reason. The patient was free from all symptoms of arsenic poisoning at that time. He was fully conscious and comfortable, but wished to be left alone. Urine passed that day contained no albumin, cells, or casts, and from then on the urine was normal. Normal blood chemistry findings were also noted. The patient recovered fully without further noteworthy happening.

During convalescense the patient stated he recalled having received both doses of neoarsphenamine at the prison. He remembered that the second dose was administered at 10.30 a. m. Tuesday, June 14, 1927. He rested in bed all afternoon and felt no ill effect of the dose that day. He said he worked all day Wednesday and had a severe headache when he went to bed. He had apparently lost all memory for events occurring after going to sleep Wednesday night.

According to his cell mate, he worked all day Thursday but complained of feeling ill at various times during the day and evening. He remembers nothing of it, but his cell mate said he got up as usual Friday morning, dressed, answered roll call, and then disappeared. His disappearance led to a search, and he was found unconscious, lying on the lawn near his cell block. It was raining heavily and he was wet through and through.

When he was discharged from the hospital, 54 days after admission, he had gained several pounds in weight and was well nourished. He had no symptoms. Psychological and neurological examinations were negative.

Since his recovery he has reported his condition by letter. In his last letter, written September 15, 1927, he stated he frequently had headache at night.

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## AN OUTBREAK OF POISONING ON BOARD THE U. S. S. "NOA" ATTRIBUTED TO LIVERWURST

By D. P. PLATT, Lieutenant, Medical Corps, United States Navy

An outbreak of food poisoning occurred on board the U. S. S. *Noa* on the morning of March 26, 1927, while the ship was at anchor at Nanking, China. Of 110 men comprising the crew, 61 showed

symptoms of poisoning. The symptoms were severe in 30 cases, marked in 10 cases, and mild in 21.

About 70 refugees—men, women, and children—had been taken on board the *Noa* at Nanking for their immediate safety and such transportation as might become necessary, making the total number of individuals on board 180.

When it became apparent during the morning that an epidemic was developing, the 70 refugees were transferred to the U. S. S. *Preston.* Two of the refugees were sick at the time of transfer, and later in the day 15 more showed symptoms of poisoning.

It seemed apparent that the food served for the evening meal on March 25 had caused the poisoning. This food consisted of sausage, baked tinned codfish, beet salad, cornstarch pudding, bread, jam, and coffee. Fifty-nine members of the crew who had symptoms of poisoning stated they had eaten sausage, pudding, and bread, and two stated they had eaten sausage and bread but none of the pudding. Twenty-one had eaten no codfish, and two no beet salad. The bread had been purchased ashore, but as it had been served to the wardroom officers, none of whom were affected, it seemed reasonable to dismiss that article of diet as a possible cause. Sausage was the only article of food eaten by all the men poisoned.

As the ship was expected to proceed up the river the following day, about 45 pounds of liverwurst had been purchased at Nanking, March 24, 1927, to meet the increased need for food supplies. The sausage was purchased from a reliable Chinese merchant who had supplied the foreign residents of Nanking with products of this sort over a long period of time during which no poisoning had occurred.

The sausage was reported as made of cooked pork, combined with beef and spices. It was stated to have been in excellent condition and well chilled when purchased, was brought to the ship without delay, and immediately placed on ice where it remained until the following day. The mean temperature at Nanking at the time varied from 40° to 44° F. On the afternoon of the following day the sausage was stripped of its covering membrane, and served cold to the crew and some of the refugees as part of the evening meal. No wardroom officer ate any of the sausage.

The first indication of poisoning seems to have appeared about 10 hours after the evening meal. The first patient was seen about 3 a. m., and by 9 a. m. 15 men had reported at the sick bay. New cases continued to be admitted until a total of 61 members of the crew were under treatment.

The patients were seen during the morning by the medical officer of the U. S. S. *Isabel*, who promptly made a diagnosis of food poisoning. The following day the ship proceeded a few miles up the river

to Wuhu, where the patients were seen by a missionary doctor, and by the medical officer of H. M. S. *Caradoc*, both of whom considered the condition an intestinal type of influenza. However, in the absence of known cases of influenza and the appearance of rapidly developing gastrointestinal symptoms in so many cases at the same time, food poisoning seemed much more probable.

Constitutional symptoms were present in every case. In general, the onset was sudden, with varying degrees of nausea, vomiting, diarrhea, abdominal pain, prostration, chills, and fever. In most cases, nausea and vomiting or diarrhea were the first symptoms. The material evacuated was watery in character and had a very foul odor, but no blood was observed or reported in any of the stools. In one case vomiting persisted for four days Prostration was an early and prominent symptom in all cases. The temperature varied from 99.4° F., in the mild cases, to 104° F., in the more severe cases.

All men were given castor oil and paregoric immediately upon reporting at the sick bay, and in the more severe cases, bicarbonate of soda followed by chlorodyne was also administered. Those still sick on the third and fourth days of the disease were given a second dose of castor oil, and milk of magnesia was given in one case in which vomiting persisted.

The U. S. S. *Noa* arrived at Shanghai on the afternoon of March 28. Seven of the more severely affected patients were transferred to the U. S. S. *Chaumont* for further treatment. One of the men still had a mild fever. The others were convalescent, though they still showed evidence of having been through a severe illness.

Due to the lack of laboratory facilities, no chemical or bacteriological examinations were made of vomitus, feces, or urine. None of the food was available for examination.

The outbreak was probably caused by the sausage which had become contaminated by a microorganism of the enteritidis-paratyphoid group of bacilli during the manufacture or subsequent storage.

This report is based upon data collected by Pharmacist's Mate, First Class, J. A. Riser, United States Navy, serving on board the *Noa* at the time of the outbreak, after the writer had seen the seven cases transferred to the *Chaumont* at Shanghai.

## A CASE OF FOOD POISONING CAUSED BY EATING CONTAMINATED FISH

The following information was furnished in conformity with the requirements of the Bureau of Medicine and Surgery questionnaire form for reporting cases of food poisoning:

I. The patient, a member of the Navy Nurse Corps, was performing ward duty at the naval hospital, Annapolis, Md., and living in the nurses' quarters on the station.

II. Fish, "that smelled of gas," was eaten by her at dinner, Friday, June 24, 1927. The meal was the regular dinner served at the nurses' quarters, and because of the peculiar odor, no other member of the mess ate it.

III. Regular hospital diet was given as the menu for the meal. The other foods taken by the patient during the period when poisoning could have occurred were not stated, nor was the place where the fish was purchased, the method of handling, preservation, or cooking, mentioned.

IV. The first symptoms appeared on June 25, 1927, about 11 hours after eating the fish.

V. No other members of the mess were affected.

VI No one else ate the fish and no other person that ate the other articles of food served at the same meal was taken ill.

VII. (*a*) The first symptom that appeared was pain and cramps in the abdomen, accompanied by sudden and severe prostration.

(*b*) The onset was sudden, colic developing 11 hours after ingesting the suspected food, and a watery diarrhea began a short time afterward.

(*c*) There was no previous disease or symptom.

(*d*) The patient had been in excellent condition before the poisoning occurred.

(*e*) A medical officer visited the patient about four hours after the first symptom appeared.

(*f*) When first seen, the patient seemed to be in distress.

(*g*) She had continuous abdominal pain, accompanied by exacerbations of more intense colic.

(*h*) Vomiting began a short time after the onset of symptoms and continued with frequent attacks for about 12 hours. The amount or appearance of the vomitus was not stated.

(*i*) There was moderate abdominal colic, but no distention was observed.

(*j*) A marked diarrhea was a prominent symptom, but the duration was not stated. The stools were watery and frequent, but no blood or hemoglobin was seen in any of the stools.

(*k*) The patient had chilly sensations, but no actual chill was experienced.

(*l*) A moderate fever developed soon after the appearance of symptoms and lasted several days.

(*m*) Moderate headache was present, but it was not localized in any definite area.

(*n*) There was no general aching. Soreness occurred over the abdomen only.

(*o*) Sudden and severe prostration appeared early in the attack, was a prominent symptom, and persisted for 10 days.

(*p*) There was some salivation after the administration of calomel, and the patient noticed a bitter taste that lasted four days. Dryness of the mouth was not a prominent symptom.

(*q*) There were no ocular symptoms or signs.

(*r*) No flushing or pallor of the face was observed.

(*s*) The pulse rate was increased during the first few days, varying slightly from 90. The systolic blood pressure was recorded as 128.

(*t*) Her respirations remained regular, with a rate of 20 per minute throughout her illness.

(*u*) No skin eruption or jaundice appeared during the course of the disease. A white blood cell count, taken on June 26, 1927, the day of the onset of symptoms, was 10,600, with polymorphonuclear leucocytes, 79 per cent; large mononuclear leucocytes, 4 per cent; and lymphocytes, 17 per cent. A second count, 10 days later, showed white blood cells 9,800; polymorphonuclear leucocytes, 81

per cent; large mononuclear leucocytes, 5 per cent; and lymphocytes, 14 per cent.

VIII. The urine was normal throughout the course of the disease. No culture was made.

IX. No chemical or bacteriological examinations were made of vomitus or stools.

X. The fish was obtained by the hospital on open purchase and prepared in the kitchen of the nurses' quarters.

XI. Canned goods were not suspected.

XII. None of the suspected food was obtainable for laboratory examination.

XIII. The food was eaten by the patient in the nurses' dining room and she had not dined in any other place for several days previous to her illness.

A brief summary of the case is as follows: About 11 hours after the patient had eaten fish of such quality that no one else at the table would partake, the patient became acutely ill with abdominal colic. This was followed soon afterwards by a thin watery diarrhea accompanied by severe prostration. Vomiting began early and continued during the first 12 to 24 hours. The pulse rate was increased and there was a moderate fever which lasted for several days. Prostration appeared early and persisted after all other symptoms had disappeared. The symptoms were such as might be expected from contamination of food with a paratyphoid bacillus, but, in the absence of bacteriological findings, the diagnosis is uncertain.

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## BACTERIAL CONTAMINATION OF KETCHUP A POSSIBLE CAUSE OF ACUTE APPENDICITIS ON BOARD U. S. S. "MISSISSIPPI"

The medical officer of the U. S. S. *Mississippi*, in August, 1926, noting that more cases of acute appendicitis were occurring among the crew of that ship than usual, endeavored to find a cause for the increased incidence. He first considered the possibility that food eaten ashore, or indiscretions in diet while men were on leave or liberty, would account for the increase. The histories given by patients did not support this supposition, but led him, rather, to look for a possible cause on board ship.

The expectancy for acute appendicitis on board a battleship was regarded as 8 to 10 cases a year, or from none to 1 or 2 a month. Cases occurred by months among the crew of the *Mississippi* as follows:

| Month | Admissions | | | Month | Admissions | | |
|---|---|---|---|---|---|---|---|
| | 1925 | 1926 | 1927 | | 1925 | 1926 | 1927 |
| January | 1 | 1 | 2 | August | 1 | 4 | ...... |
| February | 0 | 2 | 0 | September | 1 | 1 | ...... |
| March | 0 | 0 | 1 | October | 1 | 4 | ...... |
| April | 0 | 0 | 0 | November | 2 | 4 | ...... |
| May | 0 | 0 | 1 | December | 0 | 2 | ...... |
| June | 1 | 1 | ...... | | | | |
| July | 0 | 2 | ...... | Total | 7 | 21 | ...... |

Other battleships in the Battle Fleet reported cases of acute appendicitis in 1925 and 1926 as follows:

| Month | Colorado | | Idaho | | New Mexico | | Oklahoma | | Pennsylvania | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1925 | 1926 | 1925 | 1926 | 1925 | 1926 | 1925 | 1926 | 1925 | 1926 |
| January | 3 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 6 | 0 |
| February | 1 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 4 | 1 |
| March | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| April | 0 | 1 | 0 | 2 | 1 | 0 | 1 | 0 | 1 | 0 |
| May | 3 | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 2 | 0 |
| June | 0 | 1 | 3 | 0 | 0 | 1 | 2 | 2 | 4 | 0 |
| July | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 1 | 1 | 1 |
| August | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 |
| September | 0 | 2 | 0 | 0 | 1 | 1 | 1 | 4 | 1 | 0 |
| October | 0 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| November | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| December | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| Total | 8 | 10 | 8 | 5 | 10 | 4 | 9 | 8 | 21 | 3 |

Information is not available to explain why the incidence exceeded expectancy on board the *Pennsylvania*.

The *Mississippi* left Monterey, Calif., July 5, and arrived at Port Angeles, Wash., about July 10. From then until August 16 the ship was in Puget Sound ports. During this period four cases of acute appendicitis occurred. At the same time, numerous cases of a mild type, regarded as acute catarrhal fever, were occurring. Acute respiratory infections were prevalent among the several civilian population groups contacted by members of the crew, and cases in which gastrointestinal disturbances were prominent symptoms were said to be common. It is possible that influenza in mild form was present.

At first the medical officer of the *Mississippi* thought it not unlikely that microorganisms associated with the prevalent respiratory infection were responsible for increased numbers of acute appendicitis cases, but in October and November, when eight cases of appendicitis developed, the ship was in the San Pedro, Calif., area, and few persons on board had had colds of any description for several weeks.

The supply officer of the ship completed his cruise and was detached in the latter part of June. His successor began, shortly after taking over the supply department, to issue ketchup in the general mess at all meals, a provision that was greatly appreciated by the crew. For convenience, the ketchup, which was purchased in large cans, was served in regulation sauce bottles, which have porcelain spouts ringed with cork, not unlike the hair-tonic bottles seen in a barber shop. The plan was to turn all bottles in at the issue room after each meal for cleansing and refilling. Mess men did not altogether approve of this arrangement, and gradually the custom of stowing the bottles in unauthorized places about the ship spread. This made less work for mess men, and the members of the various messes also ap-

proved the unauthorized method of caring for the bottles, because ketchup was thus available between meals and could be eaten with articles of food purchased from the ship's store.

In October, a little more than a month after the ship had returned to the San Pedro area, where the weather was much warmer than in Puget Sound, the medical officer discovered that many of the ketchup bottles were not being regularly cleaned. Upon looking into the matter, he found fermented ketchup in many of the bottles, which indicated bacterial contamination. His attention was directed to the ketchup in the first place because of the frequency with which members of the crew were appearing at the sick bay complaining of intestinal colic, accompanied in some cases with diarrhea. It seemed to him that food rather than water or some other source of infection was responsible, and in many instances food eaten ashore could not have been at fault. Questioned regarding what had been eaten, many of the patients mentioned ketchup which had tasted sour.

As soon as it was appreciated that ketchup was fermenting in sauce bottles stored between meals in various parts of the ship in warm places, the matter was brought to the executive officer's attention and steps were taken immediately to insure that all bottles were turned in for cleaning and sterilizing. Mess men were no longer permitted to retain bottles after any meal. It was found impracticable to sterilize the sauce bottles with boiling water in the scullery. The risk of breakage was recognized, and at the first attempt to boil them they were placed in the sterilizing tank while the water was cold. The water in the tank was then heated gradually to the boiling point. Notwithstanding this precaution, more than a third of the first lot of bottles sterilized were found broken when removed from the tank. Mess bowls made of crockery were then substituted for the bottles. These could readily be emptied and sterilized after each meal, and there was little or no chance that ketchup would be stored in unauthorized places. The men did not have access to fermented ketchup after this episode early in November, but it appears that ketchup contaminated with microorganisms of unknown types had been more or less freely consumed by many members of the crew from about the 1st of September.

To determine, if possible, what the bacterial contamination was, the medical officer sent some of the fermented ketchup, taken with due precautions from several of the sauce bottles, to the U. S. S. *Relief* for bacteriological examination. The container was a wide mouthed bottle with a metal cap which had formerly contained malted milk. It was the only wide mouthed bottle available. The bottle was thoroughly sterilized by steam under pressure before placing the sample of ketchup in it. A chief pharmacist's mate who

took the bottle to the hospital ship was instructed to inform the laboratorian that suitable precautions had been taken. Unfortunately, it appears, that too much imagination, or lack of appreciation of conditions existing on board a battleship, led some one connected with the laboratory to assume that the specimen was forwarded in an improperly prepared container, and although it must have been understood that a specimen of food incriminated in the causation of an outbreak of disease would require thorough bacteriological investigation, no examination of value to the epidemiological study was made. A report was submitted, however, mentioning a Gram positive organism, and stating that when plated, a 1 to 10 dilution of the ketchup gave colonies too numerous to count.

The medical officer of the *Mississippi* thought it significant that cases of colic and diarrhea ceased as soon as the fermented ketchup was destroyed and cases of acute appendicitis did not thereafter exceed expectancy. It may be remarked that every case of acute appendicitis which occurred during the four months while ketchup was being issued in sauce bottles required operation, because of increasing leucocytosis and failure of symptoms to subside with expectant treatment, whereas in previous and subsequent months it was usual to find a certain proportion of patients who could have been expected to recover from the acute attack without operation.

This report is published even though conclusive evidence that the ketchup caused appendicitis was not obtained, to direct attention to the possibility that contaminated food may be a causative factor in some cases of appendicitis.

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## ATTITUDE OF THE AMERICAN PSYCHIATRIC ASSOCIATION REGARDING THE ADMINISTRATION OF AMERICAN CRIMINAL LAW

The following editorial, "A Notable Document," is reprinted from the Mental Hygiene Bulletin, June, 1927, published by the National Committee for Mental Hygiene, New York City:

Among the weaknesses in the administration of American criminal law none has stood out more conspicuously in recent years than that manifested in connection with the "insanity plea." The methods of securing "expert testimony" as to the mental condition of persons on trial for criminal offenses have bred a situation that has long been stultifying to medicine and the law alike. Psychiatry took up the challenge three years ago when, reacting to the unfavorable public sentiment generated by the unfortunate procedures attending the handling of certain prominent criminal cases and brought to a focus at the time of the Loeb-Leopold "hearing in mitigation," the American Psychiatric Association appointed a committee from its own group to study the question. Since then this committee has given close attention to the whole problem of the relation of psychiatry to the law, not only in respect to the

matter of "expert testimony," but with reference to the problem of crime in general. Indeed, it considers the "alienist" question of minor importance compared to that of utilizing the knowledge gained by psychiatry and criminology regarding human behavior in the modification of the entire system of criminal-law procedure.

The committee's report was the outstanding feature of the business transacted at the association's eighty-third annual meeting held in Cincinnati on June 2. As a definitive statement of the position of psychiatry on the question of crime, it is perhaps one of the most important documents ever issued by the association, representing, as it does, authoritative American psychiatric opinion in general, and the mature thought and conviction of a group interested in the criminological aspects of psychiatry in particular.

A discussion of the theoretical considerations involved in the "psychiatric point of view" and a list of practical recommendations for the advancement of this point of view among those responsible for the administration of our criminal laws make up the burden of the report. Its major premise is that psychiatry should not be called upon to deal with questions of responsibility at all, but should be enlisted solely in attempts to find out the facts concerning the make-up and nature of the prisoner at the bar. What manner of man is he? What is this individual's mental, physical, emotional, and social status? What are the motives back of his criminal conduct? What are the factors that impinge upon his personality and have a bearing upon his behavior? For the psychiatrist none are "incompetent, irrelevant, or immaterial."

A second cardinal point in the philosophy of the report is its insistence upon individualization in the treatment of the offender. To this end it favors "radical changes in legislative enactment and legal procedure and penal practice," advocating, for example, the adoption of proposals made by the American Institute of Criminal Law and Criminology, with respect to trial procedure, (*a*) that the disposition of all misdemeanants and felons be based upon study of the individual offender by properly qualified and impartial experts cooperating with the courts; (*b*) that such experts be appointed by the courts with provision for remuneration from public funds; (*c*) that no maximum term be set to any sentence; (*d*) that prisoners be discharged or released upon parole only after complete and competent psychiatric examination with findings favorable for successful rehabilitation; (*e*) that the incurably inadequate, incompetent, and antisocial offenders be interned permanently, without regard to the particular offense committed; (*f*) that the use of the "hypothetical question" and of the terms "insane" and "insanity" and "lunacy" be abolished, etc. It is the belief of the committee that such a program will operate more effectively to secure the protection of society, bring about the socialization of the criminal, and serve the ends of justice, than all the repressive measures legislative ingenuity or short-sighted police control can devise.

It is significant that these recommendations should be in substantial agreement with those of a body of men who have to deal with the problem of the criminal in its most practical aspects, experts in their line who have tried and found wanting the traditional legalistic methods—the delegates to the Ninth International Prison Congress held in London in 1925. That the thinking of penologists and psychiatrists on such a moot and vital question is essentially the same is evident from the identity of the principles used in the formulation of both groups, and should augur well for a rapprochement between medicine and the law in the interests of an improved criminal code, a more socially intelligent management of the criminal, and better control of crime and delinquency. That progress is being made is evident in the experience that has already followed

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from the recent enactment of forward-looking and enlightened legislation in Massachusetts, from certain salutary changes in penal administration effected in New York State, and the practical applications made from studies by the National Crime Commission and a number of similar State bodies.

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## A BRIEF SUMMARY OF BACTERIAL METHODS AND STANDARDS IN WATER ANALYSIS

**The following article by H. W. Clark, Director, Division of Water and Sewage Laboratories, Massachusetts Department of Public Health, is reprinted from "The Commonhealth," July-August-September, 1927:**

Bacteriology and bacterial methods have been a slow growth of the last 40 years. When the Lawrence Experiment Station was started, in the laboratories of which all the bacterial work upon water, sewage, industrial wastes, shellfish, etc., of the department is carried on, bacteriological methods were in their infancy. Only six years before that date Koch had proposed the use of solid media by means of which quantitative determinations of the numbers of bacteria and the isolation or study of species of bacteria became possible. The use of the Petri dish which extended the scope of the Koch methods and made possible the rapid and accurate determinations of the number of bacteria in water, etc., now so common, was proposed in the same year that the Lawrence experiments were inaugurated (1887) but was not generally adopted until several years later. Soon after the establishment of the station, or in the early nineties of the last century, a committee of the American Public Health Association was formed to standardize chemical, bacterial, and miscroscopical methods for the examination of water. From the beginning, members of the force of this division were on this committee and through many years different members of this force served as chairman as well as being connected with similar committees of the American Chemical Society, the American Water Works Association and the United States Public Health Service, and for many years determinations of bacteria in the water supplies of the State have been carried on at Lawrence, largely by the standard methods partly developed there. Further, during recent years the quality of water supplies has been judged quite largely by standards of purity established by these various committees. In 1925 the advisory committee on official water standards of the United States Public Health Service in its report made the following statement:

"The bacteriological examinations which have come to be generally recognized as of most value in the sanitary examination of water supplies are—

"(1) The count of total colonies developing from measured portions planted on gelatin plates and incubated for 48 hours at 20° C.

"(2) A similar count of total colonies developing on agar plates incubated for 24 hours at 37° C.

"(3) The quantitative estimation of organisms of the B. coli group by applying specific tests to multiple portions of measured volume.

"Of these three determinations the test for organisms of the B. coli group is almost universally conceded to be the most significant, because it affords the most nearly specific test for the presence of fecal contamination."

Taking everything into consideration the committee agreed to include this latter test only in the bacteriological standard recommended, stating, however, that the omission of plate counts, etc., was not to be construed as denying or minimizing the importance of such routine examinations made in the control of

purification processes and they also stated that the B. coli group should be defined as in the publication known as the "Standard Methods of Water Analysis," issued by the American Public Health Association, namely, "as including all nonspore-forming bacilli which ferment lactose with gas formation and grow aerobically on standard solid media."

While as stated above this division has quite generally followed the standard methods, we have had to vary them to some extent owing to the great variety of the samples examined by us. For example, we discontinued many years ago the use of gelatin and incubation for 48 hours and use instead agar and count after four days' incubation. This is necessary owing to the great number of examinations of sewage and badly polluted water lost by the liquefaction of gelatin. We differ from the standard methods in partial confirmation, so called, of the coli aerogenes group in that we use litmus lactose agar instead of endo or eosin methylene blue as recommended. The procedure used by us has always given satisfactory results. The statement in the "Standard Methods of Water Analysis" that "our knowledge is not sufficiently complete to warrant the adoption of any single test or group of tests" in differentiation of fecal from nonfecal members of the coli-aerogenes group is in accordance with the experience of these laboratories and we believe that until further information is gained any member of this group when found should be reported as B. coli and in addition that streptococci when found on confirmation plates have the same significance as B. coli. The carrying out of the entire series of B. coli confirmation tests adopted by the various committees and given in Standard Methods is impossible for this laboratory, generally speaking, with the force employed and when samples are coming in with great rapidity and, in fact, few laboratories carry all these tests to completion. Each year several hundred samples and cultures are carried by us through the complete series of confirmatory tests, however, and the results year after year have shown that 98 per cent of our coli results as reported are not changed or eliminated when the complete tests are used. For example, in 1926, 161 cultures reported as B. coli according to our usual methods were further examined according to the procedure outlined under steps E and F on page 108 of Standard Methods, 1925 edition, and of these 158 were completely confirmed. In addition the 158 completely confirmed cultures were further examined by the Gram test and were found to be Gram negative. This is typical of all our work on confirmation.

In regard to the significance of red colonies developing in 24 hours on litmus lactose agar plates the following statement can be made: All such colonies are counted by us without regard to their resemblance to typical B. coli. These plates are made in 0.1 of a cubic centimeter, 1 cubic centimeter and in five 10 cubic centimeter portions in a liquid medium, and this liquid medium is much more favorable to the development of attenuated bacteria. Consequently B. coli are often found in the 10 cubic centimeter portions and even occasionally in the 1 cubic centimeter portions, although no red colonies develop on the 24-hour plates. It has been our experience that a very small number of the red colonies on these plates are confirmed as B. coli when found in what may be classed as good waters, while in waters of poorer quality the number is much higher.

The standard of quality decided upon by the advisory committee of the United States Public Health Service is as follows:

"(1) Of all the standard (10 cubic centimeters) portions examined in accordance with the procedure specified below, not more than 10 per cent shall show the presence of organisms of the B. coli group.

"(2) Occasionally three or more of the five equal (10 cubic centimeters) portions constituting a single standard sample may show the presence of B. coli. This shall not be allowable if it occurs in more than—

"(a) Five per cent of the standard samples when 20 or more samples have been examined;

"(b) One standard sample when less than 20 samples have been examined."

This standard is very rigid, and only waters of the greater bacterial purity can conform to it. It has been of interest, however, during the past year or two, to compare certain of the water supplies of this State with this standard, and it is apparent, as would be expected, that the greater the number of samples collected and examined the more definite is the amount of information obtained in regard to these waters and that none should be judged from the results of the examination of a few samples. Enough have been taken, however, from the metropolitan supply of the State as delivered to its consumers to show that 90 per cent of the samples are of the required quality and that most of the good surface-water supplies which are stored in lakes and reservoirs will also meet the requirements of the standard in a large percentage of the samples examined. The most polluted source of water supply in the State, the Merrimack River, is used by the city of Lawrence after slow sand filtration and chlorination. Seven hundred and two examinations of this supply as delivered to the consumers were made during 1926, and 91 per cent of these samples passed this rigid standard. The typhoid-fever death rate of Lawrence during the year was at the exceedingly low point of 1.1 per 100,000. It is unnecessary to say that practically all the good ground waters of the State, as drawn from driven wells 25 to 50 feet deep, also pass the standard, and, in conclusion, it can be stated that of the total number of samples of public supplies examined during 1926, 88 per cent were satisfactory according to this United States Public Health Service standard of quality.

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## TYPHOID FEVER SITUATION IN THE WORLD

The following report on typhoid fever in the world is taken from the September 15 issue of the monthly epidemiological report of the health section of the League of Nations Secretariat:

The enteric fever situation was on the whole favorable in July in most European countries. In England the incidence decreased toward the end of July, while fewer cases than usual were reported in July in Denmark, Norway, Sweden, and Finland. In England and Wales, there were 321 cases during the four weeks ended August 20, as compared with 406 cases during the previous four weeks, although the incidence ordinarily increases markedly at this time of the year. In Germany, fewer cases were reported in July and early August than during the corresponding months of any previous year. It is to be noted in this connection that exceptionally cool and wet weather prevailed over the northern part of Europe in June and early in July.

Further south in Europe the incidence may be characterized as normal, except in Italy, where it was above the normal (2,100 cases during the four weeks ended July 3, as against 1,274 cases during the corresponding period of the previous year). In the Serb-Croat-Slovene Kingdom, the incidence was also higher than last year and there was an outbreak at Belgrade, where 48 cases were reported during the first week of August; it seems to have been promptly controlled, as there were only 10 cases the following week. The crest of the seasonal curve for enteric fever is not reached until September or October, but its low prevalence in summer in many countries is probably of good augury for the autumn.

In the United States, 3,878 cases were reported during the four weeks ended July 30, as compared with 3,496 cases during the corresponding period of 1926.

In Canada, the enteric fever situation is entirely dominated by the formidable epidemic at Montreal. This epidemic, which appeared to be coming to an end in the latter half of April, broke out afresh early in May. There were nearly as many cases in the second wave as in the first. A recrudescence of this magnitude is a most unusual phenomenon.

From the beginning of the epidemic and up to July 9, 4,849 cases were reported and 489 deaths were ascribed to typhoid fever. Notifications numbered 2,604 in March and April, which may roughly be taken to correspond with the first wave, and 2,242 in the second wave between May 1 and July 9. If the deaths reported up to May 7 are taken as corresponding to the first wave, there were 251 deaths during the first and 234 during the second wave. Deaths due to the first wave occurring after May 7 will probably be approximately compensated by those who may have died after July 9, returns for which have not as yet been received. This would give a case mortality rate of 9.6 per cent in the first and 10.4 per cent in the second wave.

The circumstances which produced the second wave were evidently already in operation in the latter half of April, when the notifications showed only the tail-end of the first wave. It may be noted, in this connection, that, in 1926, there were 256 deaths from typhoid fever in the Province of Quebec (203 in the remainder of Canada), and that only 571 typhoid cases were reported.

It is confirmed that the origin of the epidemic was due to milk-borne infection.

The proportion of hospitalized patients is a little over 33 per cent of the total. Convalescents are discharged when two examinations of feces and of urine made at intervals of not less than three days have given negative results.

A high proportion of the cases were among children; 35.5 per cent of the cases for which the age is stated were under 10 years of age and 32.2 per cent between 10 and 20 years.

Mortality statistics are on the whole more complete than morbidity statistics and are therefore more readily comparable for different countries—at any rate, for diseases in case of which the diagnosis does not present too great difficulties. As statistics of causes of death for 1926 are so far available only for a few countries, the enteric fever death rates for 1925 and 1926 are given below for groups of large towns.

| | Population (in thousands) | Deaths | | Rate per 100,000 population | |
|---|---|---|---|---|---|
| | | 1925 | 1926 | 1925 | 1926 |
| 107 English towns | 19,411 | 183 | 140 | 0.9 | 0.7 |
| 16 Scottish towns | 2,396 | 24 | 23 | 1.0 | 1.0 |
| 3 Scandinavian towns | 1,300 | 11 | 11 | .8 | .8 |
| 48 German towns | 17,024 | 336 | 483 | 2.0 | 2.8 |
| 47 German towns [1] | 16,597 | 330 | 223 | 2.0 | 1.3 |
| 14 Dutch towns | 2,411 | 57 | 44 | 2.4 | 1.8 |
| 30 Swiss towns | 1,184 | 16 | 13 | 1.4 | 1.1 |
| 2 Belgian towns | 1,126 | 39 | 22 | 3.5 | 2.0 |
| 5 French towns | 3,932 | 222 | 214 | 5.6 | 5.4 |
| 7 Italian towns | 3,447 | 483 | 646 | 14.0 | 18.7 |
| 49 Spanish towns | 4,263 | 890 | 1,081 | 20.9 | 25.4 |
| 4 Czechoslovakian towns | 1,176 | 97 | 84 | 8.2 | 7.1 |
| 4 Polish towns | 1,995 | 256 | 308 | 12.8 | 15.4 |
| 79 Ukrainian towns | 3,460 | 443 | 528 | 12.8 | 15.3 |
| 2 towns of the Union of Socialistic Soviet Republics | 3,632 | 463 | 409 | 12.7 | 11.3 |
| 2 Egyptian towns | 1,351 | 445 | 438 | 32.9 | 32.4 |
| 21 Japanese towns | 8,741 | -------- | 2,325 | -------- | 26.3 |
| 4 Indian towns | 3,128 | 909 | 1,057 | 29.1 | 33.8 |
| 80 towns of the United States | 29,621 | 993 | 822 | 3.4 | 2.8 |

[1] Without Hanover.

It is seen that in Europe the incidence of enteric fever in general increases from north to south; in England and in the Scandinavian countries, the mortality is less than 1 per 100,000 inhabitants; in German, Dutch, and Swiss towns it is mostly between 1 and 2 per 100,000, exception made of the explosive outbreak at Hanover, when the death rate rose to 60.9 in 1926. In southern and eastern Europe the death rates from enteric fever are mostly between 10 and 20 per 100,000; in certain Spanish and Italian towns they exceeded 30. At Athens the rate was 39.3 and at Salonica 44.1 in 1924.

The mortality in European towns was on the whole lower in 1926 than in 1925, with exception of Spanish, Italian, Polish, and Ukrainian towns, where the rates were higher.

Similarly in the United States, the mortality from enteric fever is mostly below 2 per 100,000 in the northern towns, but exceeds 10 in most towns of the South. It was on the average lower in 1926 than in 1925.

*Mortality in 1926 in large towns of the United States grouped according to geographical divisions*

| | Population (in thousands) | Deaths | Rate per 100,000 |
|---|---|---|---|
| New England | 2,522 | 38 | 1.5 |
| Middle Atlantic | 11,399 | 241 | 2.1 |
| South Atlantic | 2,226 | 120 | 5.4 |
| North Central | 10,596 | 192 | 1.8 |
| South Central | 2,314 | 294 | 12.7 |
| Rocky Mountain and Pacific | 3,431 | 68 | 2.0 |

In subtropical and tropical countries, enteric fever is even more prevalent than in southern Europe or in the Southern States of the United States. The mortality per 100,000 inhabitants in 1926 was thus: 38.9 in Cairo, 82.4 in Teheran, 68.9 in Calcutta, 29.1 in Singapore, 35.9 in Batavia, and 29.1 in Manila. It is probable that in several of these towns the certification of causes of death is less accurate than in European towns and the rates may therefore in some instances be too low.

In South America the incidence of enteric fever is lowest in the southern temperate climates and generally increases northward. The death rate from this cause per 100,000 in 1926: 4.4 at Buenos Aires, 14.2 at Montevideo, 41.4 at Sao Paulo, 8.5 at Rio de Janeiro (low for the latitude), 33.7 at Lima, and 92.8 at Bogota.

Mortality statistics for 1926 are available for the countries shown below; the rates do not differ greatly from those given above for large towns in the same countries.

*Mortality from enteric fever in various countries in 1926*

| | Population (in thousands) | Deaths | Rate per 100,000 |
|---|---|---|---|
| England and Wales | 39,067 | 367 | 0.9 |
| Scotland | 4,903 | 39 | .8 |
| The Netherlands | 7,449 | 137 | 1.8 |
| Switzerland | 3,959 | 59 | 1.5 |
| Germany | 62,612 | 1,102 | 1.8 |
| Czechoslovakia | 14,353 | 1,183 | 8.2 |
| Spain | 22,128 | 4,747 | 21.5 |
| Canada | 9,291 | 461 | 5.0 |

## NOTES ON THE PREPARATION OF FORM F CARD AND FORM F (SMOOTH)

In order that the errors in the preparation of Form F card and Form F (smooth) may be reduced, and that the return of these forms for verification may be avoided, the following notes are published for medical officers, pharmacists, and others responsible for their preparation.

*Aviation.*—Form F cards reporting injuries resulting from crashes shall always state whether injury occurred in a landplane, a seaplane, or an amphibian plane. The title "airplane" should not be used in reporting such cases.

Medical officers should use particular care in using the designation "Aviation-flight" or "Aviation-ground" when reporting admissions to the sick list of aviation personnel on Form F cards. The definitions of the titles to be used in this regard are stated clearly in paragraph 3418 (g), Manual of the Medical Department, 1927, and it is recommended that this paragraph be carefully studied before Form F cards are made for aviation personnel. While the instructions require the use of the designation "Aviation-flight" or "Aviation-ground," as defined, for all personnel engaged in aviation activities, regardless of rating, morbidity cards for persons of aviation ratings are closely scrutinized when received in the bureau, and are invariably questioned when the designation is not used. It is realized that men of aviation ratings are often not assigned to aviation duties, and, consequently, when admitted to the sick list, paragraph 3418 (g) would not apply. Therefore, in order to avoid the necessity of having the Form F card returned for verification, it is suggested that the following be entered on the back of the card for all such cases—"Par. 3418 (g) does not apply."

Paragraph 3419 (h) defines the method of reporting the average complement of aviation personnel on Form F (smooth). Medical officers are requested to follow these instructions closely. It is very important that these figures be accurately reported, as the annual rates of morbidity and mortality of the flight personnel of the Navy are based on the figures supplied on these reports.

*Submarines.*—Form F cards reporting persons admitted to the sick list while attached to submarines shall invariably show the name of the vessel to which attached as well as the ship or station reporting the case. Attention is invited to paragraph 3418 (h), Manual of the Medical Department, United States Navy, 1927. Form F cards reporting injuries occurring among submarine personnel should specify if the injury occurred on board the submarine or elsewhere.

All circumstances pertinent to the cause of the accident should be recorded on the back of the Form F card in every case of injury to naval personnel.

*Cases continued to next year.*—As a timely reminder, medical officers and others responsible for the preparation of the Form F card are requested to familiarize themselves with the instructions contained in paragraph 3418 (c), Manual of the Medical Department, United States Navy, 1927.

Special attention is invited to the method of recording the date of disposition on the cards closed out at the end of the year and the method of recording the date "taken up" and the sick days on the cards for the ensuing year.

New cards made at naval hospitals and other places receiving patients, for cases carried over at the end of the year, should always indicate on line 4 the ship or station from which the patient was received.

## HEALTH OF THE NAVY

The general admission rate from all causes, based on returns for July, August, and September, 1927, was 527 per 1,000 per annum. This rate is slightly higher than that for the preceding quarter due to an increase of 9 per cent for venereal diseases and an increase of 11 per cent for diseases of the digestive system. An increase in admissions for accidents and injuries was noted over those for the preceding quarter. Records of the preceding five years show that the median rate from all causes for the corresponding three months is 524.

Complete reporting has been promoted in every way possible and a greater number of cases taken up on morning reports of sick for one or two days has doubtless tended to increase admission rates. Admission rates now more truly indicate the actual number of cases of diseases and injuries treated than formerly.

The admission rate from accidental injuries was 55 per 1,000 per annum during the quarter. Expectancy, as indicated by the median rate of the preceding five years, for the months of July, August, and September, was 61.

Health conditions ashore were satisfactory for the quarter. Diseases of the respiratory type, however, continued prevalent at the United States Naval Training Station, Hampton Roads, Va., where 101 cases of influenza, 371 cases of catarrhal fever, and 14 cases of measles were reported. Forty-three cases of mumps were also notified.

Reports from forces afloat indicate that morbidity rates for diseases and accidents and injuries did not exceed expectancy. An outbreak of gastroenteritis involving 24 persons occurred on the U. S. S. *Melville* during July. Investigation revealed the presence of a microorganism having the general cultural characteristics of the

*B. dysenteriae* (Flexner-Strong) type in one of the fresh-water tanks. This outbreak will be discussed in the next issue of the United States Naval Medical Bulletin.

One case of cerebrospinal fever, terminating fatally, was reported from the U. S. S. *Mississippi* during August. No other case of this disease was reported from any ship or shore station.

Table No. 1.—*Summary of morbidity in the United States Navy and Marine Corps for the quarter ended September 30, 1927*

| | Forces afloat | Forces ashore | Marine Corps | Entire Navy |
|---|---|---|---|---|
| Average strength | 76,240 | 39,125 | 19,536 | 115,365 |
| All causes: | | | | |
| Number of admissions | 8,118 | 7,069 | 3,024 | 15,187 |
| Annual rate per 1,000 | 425.92 | 722.71 | 619.16 | 526.57 |
| Disease only: | | | | |
| Number of admissions | 7,193 | 6,375 | 2,755 | 13,568 |
| Annual rate per 1,000 | 377.39 | 651.76 | 564.09 | 470.44 |
| Communicable diseases, exclusive of venereal disease: | | | | |
| Number of admissions | 1,796 | 2,447 | 716 | 4,243 |
| Annual rate per 1,000 | 94.23 | 250.17 | 146.60 | 147.12 |
| Venereal diseases: | | | | |
| Number of admissions | 2,688 | 1,351 | 962 | 4,039 |
| Annual rate per 1,000 | 141.01 | 138.12 | 196.97 | 140.04 |
| Injuries: | | | | |
| Number of admissions | 911 | 683 | 267 | 1,594 |
| Annual rate per 1,000 | 47.80 | 69.83 | 54.67 | 55.27 |
| Poisoning: | | | | |
| Number of admissions | 14 | 11 | 2 | 25 |
| Annual rate per 1,000 | .73 | 1.12 | .41 | .87 |

Table No. 2.—*Deaths reported, entire Navy, during the quarter ended September 30, 1927*

| | | Navy | | | Marine Corps | | Nurse Corps | Total |
|---|---|---|---|---|---|---|---|---|
| | | Officers | Midshipmen | Men | Officers | Men | Nurses | |
| Average strength | | 8,888 | 1,523 | 84,960 | 1,200 | 18,302 | 492 | 115,365 |
| Causes: Diseases | | | | | | | | |
| Primary | Secondary or contributory | | | | | | | |
| Abscess, brain | Septicemia | | | | | 1 | | 1 |
| Abscess, liver | Myocarditis, acute | | | | | 1 | | 1 |
| Do | Pleurisy, suppurative | | | 1 | | | | 1 |
| Abscess, lung | Pneumonia, broncho | | | 1 | | | | 1 |
| Abscess, retropharyngeal. | Edema, glottis | | | 1 | | | | 1 |
| Alcoholism, acute | Gastritis, acute | | | 1 | | | | 1 |
| Anemia, pernicious | Purpura, hemorrhagica. | | | 1 | | | | 1 |
| Angina, Ludwig's | None | | | 1 | | | | 1 |
| Appendicitis acute | Obstruction, intestinal, from paralytic cause. | | | 1 | | 1 | | 2 |
| Do | Pneumonia, broncho | | | 1 | | | | 1 |
| Do | Peritonitis, acute general. | | | 2 | | 2 | | 4 |
| Do | Peritonitis, acute local | | | 1 | | | | 1 |
| Carcinoma, liver | None | | | 1 | | | | 1 |
| Carcinoma, rectum | do | | | 1 | | | | 1 |
| Cellulitis, right great toe. | Pyemia | | | 1 | | | | 1 |

**Table No. 2.**—***Deaths reported, entire Navy, during the quarter ended September 30, 1927***—Continued

| | | Navy | | | Marine Corps | | Nurse Corps | Total |
|---|---|---|---|---|---|---|---|---|
| | | Officers | Midshipmen | Men | Officers | Men | Nurses | |
| **Causes: Diseases** | | | | | | | | |
| Primary | Secondary or contributory | | | | | | | |
| Cerebrospinal fever | Pneumonia, broncho | | | 1 | | | | 1 |
| Dengue | Nephritis, acute | | | 1 | | | | 1 |
| Gastritis, acute | Dilatation, cardiac, acute. | | | 1 | | | | 1 |
| Hodgkin's Disease | Pyelonephritis | | | 1 | | | | 1 |
| Influenza | Nephritis, acute | | | 1 | | | | 1 |
| Malaria | Blackwater fever | | | | | 1 | | 1 |
| Do | Dysentery, entamebic | | | | | 1 | | 1 |
| Meningitis cerebrospinal. | Pneumonia, broncho | | | | | 1 | | 1 |
| Nephritis, acute | None | | | 2 | | | | 2 |
| Nephritis, chronic | Myocarditis, chronic | 1 | | | | | | 1 |
| Pneumonia, lobar | None | | | 1 | | 1 | | 2 |
| Psychosis-intoxication alcoholic. | Myocarditis, chronic | | | 1 | | | | 1 |
| Sunstroke | None | | | | | 1 | | 1 |
| Syphilis | Nephritis, chronic | | | 1 | | | | 1 |
| Do | Poisoning, neorsphenamine, acute. | | | 2 | | | | 2 |
| Tonsilitis, acute | Pneumonia, broncho | | | 1 | | | | 1 |
| Tuberculosis, chronic pulmonary. | None | | | 1 | | 2 | | 3 |
| Do | Endocarditis, chronic | | | 1 | | | | 1 |
| Do | Hemorrhage, pulmonary. | | | 1 | | | | 1 |
| Do | Nephritis, chronic | | | | | 1 | | 1 |
| Do | Pneumonia, broncho | | | 1 | | | | 1 |
| Do | Tuberculosis, meningeal. | | | 1 | | | | 1 |
| Tuberculosis, acute, general, miliary. | None | | | 1 | | | | 1 |
| Tumor, benign, brain | do | | | 1 | | | | 1 |
| Ulcer, duodenum | Dilitation, acute cardiac. | 1 | | | | | | 1 |
| Do | Pneumonia, broncho | | | 1 | | | | 1 |
| Total for diseases | | 2 | | 35 | | 13 | | 50 |
| **Causes: Injuries and poisoning** | | | | | | | | |
| Burns, multiple | None | 1 | | 1 | | | | 2 |
| Contusions, multiple | Pneumonia, broncho | | | 1 | | | | 1 |
| Electric shock, injury from. | None | | | 1 | | 1 | | 2 |
| Fracture, compound, skull. | do | | | 1 | | | | 1 |
| Do | Hemorrhage, traumatic left chest. | | | 1 | | | | 1 |
| Do | Rupture, traumatic, liver. | | | 1 | | | | 1 |
| Fracture, simple, skull. | None | | | 5 | | 1 | | 6 |
| Do | Hemorrhage, subdural | | | 1 | | | | 1 |
| Fracture, simple, nose. | Septicemia | | | 1 | | | | 1 |
| Intracranial injury | None | | | 1 | | | | 1 |
| Injuries, multiple, extreme. | do | | | 2 | | 1 | | 3 |
| Landplane crash: Injuries multiple, extreme. | do | 2 | | 2 | | | | 4 |
| Injuries, multiple, extreme. | Meningitis, cerebrospinal. | | 1 | | | | | 1 |

TABLE No. 2.—*Deaths reported, entire Navy, during the quarter ended September 30, 1927*—Continued

| CAUSES: DISEASES | | Navy | | | Marine Corps | | Nurse Corps | Total |
|---|---|---|---|---|---|---|---|---|
| Primary | Secondary or contributory | Officers | Midshipmen | Men | Officers | Men | Nurses | |
| Wound, penetrating abdomen. | None | | | | | 2 | | 2 |
| Do | Peritonitis, acute general. | | | | | 1 | | 1 |
| Wound, penetrating brain. | None | | | 1 | 1 | 2 | | 4 |
| Wound, penetrating buttock. | Hemorrhage, femoral | | | | | 1 | | 1 |
| Wound, penetrating chest. | do | | | | | 1 | | 1 |
| Wound, penetrating right malar. | do | | | | | 1 | | 1 |
| Wound, penetrating heart. | do | | | | | 1 | | 1 |
| Wounds, multiple, extreme. | do | | | | | 1 | | 1 |
| Do | Hemorrhage, traumatic. | | | | | 1 | | 1 |
| Wound, explosion, brain. | None | | | 1 | | | | 1 |
| Drowning | do | | | 19 | | 3 | | 22 |
| Poisoning, acute, chloroform inhalation. | do | | | 1 | | | | 1 |
| Poisoning, acute, food (bacterial toxin), club sandwich. | | | | 1 | | | | 1 |
| Poisoning, acute, illuminating gas. | None | | | 1 | | | | 1 |
| Poisoning, acute, opium. | do | | | 1 | | | | 1 |
| Poisoning, acute, phenol. | do | | | 1 | | | | 1 |
| Total for injuries and poisoning | | 3 | 1 | 44 | 1 | 17 | | 66 |
| Grand total | | 5 | 1 | 79 | 1 | 30 | | 116 |
| ANNUAL DEATH RATE PER 1,000 | | | | | | | | |
| All causes | | 2.25 | 2.63 | 3.72 | 3.33 | 6.56 | | 4.02 |
| Disease only | | .90 | | 1.65 | | 2.84 | | 1.73 |
| Drowning | | | | .89 | | .66 | | .76 |
| Injuries | | 1.35 | 2.63 | .94 | 3.33 | 3.06 | | 1.35 |
| Poisoning | | | | .24 | | | | .17 |

## STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following table was constructed with figures taken from monthly reports submitted by naval training stations:

*Cumulative data*

| | Number | Per cent of recruits received | Per cent of recruits reviewed |
|---|---|---|---|
| JAN. 1 TO DEC. 31, 1926 | | | |
| All naval training stations: | | | |
| Recruits received during the period | 16,212 | | |
| Recruits appearing before board of medical survey | 842 | 5.19 | |
| Recruits recommended for discharge from the service | 496 | 3.06 | 58.91 |
| JULY, AUGUST, AND SEPTEMBER, 1927 | | | |
| U. S. naval training station, Hampton Roads, Va.: | | | |
| Recruits received during the period | 1,163 | | |
| Recruits appearing before board of medical survey | 53 | 4.56 | |
| Recruits recommended for discharge from the service | 53 | 4.56 | 100.00 |
| U. S. naval training station, Great Lakes, Ill.: | | | |
| Recruits received during the period | 1,325 | | |
| Recruits appearing before board of medical survey | 77 | 5.81 | |
| Recruits recommended for discharge from the service | 26 | 1.96 | 33.77 |
| U. S. naval training station, San Diego, Calif.: | | | |
| Recruits received during the period | 984 | | |
| Recruits appearing before board of medical survey | 52 | 5.28 | |
| Recruits recommended for discharge from the service | 52 | 5.28 | 100.00 |
| U. S. naval training station, Newport, R. I.: | | | |
| Recruits received during the period | 1,445 | | |
| Recruits appearing before board of medical survey | 34 | 2.35 | |
| Recruits recommended for discharge from the service | 29 | 2.01 | 85.29 |

## ADMISSIONS FOR INJURIES AND POISONING, THIRD QUARTER, 1927

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the third quarter, 1927, is based upon all Form F cards, covering admissions in those months, which have reached the bureau:

| | Admissions, July, August, and September, 1927 | Admission rate per 100,000 per annum | Admission rate per 100,000, year 1926 |
|---|---|---|---|
| INJURIES | | | |
| Connected with work or drill | 768 | 2,663 | 3,036 |
| Occurring within command but not associated with work | 492 | 1,706 | 2,017 |
| Incurred on leave or liberty or while absent without leave | 334 | 1,158 | 1,086 |
| All injuries | 1,594 | 5,527 | 6,139 |
| POISONING | | | |
| Industrial poisoning | 6 | 21 | 53 |
| Occurring within command but not connected with work | 9 | 31 | 195 |
| Associated with leave, liberty, or absence without leave | 10 | 35 | 126 |
| Poisoning, all forms | 25 | 87 | 374 |
| Total injuries and poisoning | 1,619 | 5,614 | 6,513 |

*Percentage relationships*

| | Occurring within command | | | | Occurring outside command | |
|---|---|---|---|---|---|---|
| | Connected with the performance of work, drill, etc. | | Not connected with work or prescribed duty | | Leave, liberty, or A. W. O. L. | |
| | July, August, and September, 1927 | Year, 1926 | July, August, and September, 1927 | Year, 1926 | July, August, and September, 1927 | Year, 1926 |
| Per cent of all injuries | 48.2 | 49.4 | 30.9 | 32.9 | 20.9 | 17.7 |
| Per cent of poisonings | 24.0 | 14.1 | 36.0 | 52.2 | 40.0 | 33.7 |
| Per cent of total admissions, injury and poisoning titles | 47.8 | 47.4 | 30.9 | 34.0 | 21.3 | 18.6 |

Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction," or "Alcoholism," as the case may be. Such cases are not included in the above figures.

The following cases, selected from July, August, and September, 1927 reports, are worthy of notice from the standpoint of accident prevention:

*Hatchway hazards.*—A man fell through an open hatch on board a receiving ship. The ladder had been removed before the rope guard was placed at the entrance. Injury, sprain of ankle. Loss of time, 6 days.

*Hatch-cover hazards.*—Due to negligence of others, a hatch cover which had not been secured fell while a man was entering the trainer's pit. Injury, fracture of a finger. Loss of time, 4 days.

Failure, through carelessness, properly to secure a hatch cover resulted in the injury of an officer when the cover fell. Injury, lacerated wound of the scalp. Loss of time, 3 days.

A carelessly secured hatch-cover pin caused the cover to fall while it was being opened. A man received a lacerated wound of the hand requiring 19 days treatment on the sick list.

Failure to put a hatch-cover pin in place caused the cover to fall when a man ascended the ladder. He received a crushing injury of four fingers. Loss of time, eight days.

*Gasoline hazards.*—Gasoline, collecting on the deck of a destroyer while a man was using it to remove oil from paint work, was ignited by a carelessly thrown cigarette. The man received burns of a leg. Loss of time, 14 days.

A fireman, on board ship, used gasoline instead of kerosene to start a fire. The resulting explosion caused severe burns of the face. Loss of time, eight days.

A ship's cook used gasoline to clean paint. He then started a fire in a range without taking the precaution to wash his hands. He received burns of the hands for which he was treated in hospital 53 days.

*Careless handling of firearms.*—While a sentry was examining the chamber of a rifle, it was accidentally discharged. He received a wound of a hand which disabled him for 12 days.

*Carelessness resulting in the explosion of cartridges.*—A chief petty officer received wounds of an eye from flying particles when cartridges carelessly thrown into a camp fire by another person exploded. The wounds resulted in loss of the eye and 109 sick days.

*Chemical agents, disinfectants, and drugs.*—An apprentice seaman at a training station mistook a bottle of cresol solution, that had been carelessly left by another, for orange crush. Burns of the mouth disabled him for three days.

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VOL. XXVI APRIL, 1928 No. 2

# UNITED STATES NAVAL MEDICAL BULLETIN

PUBLISHED QUARTERLY FOR THE INFORMATION OF THE MEDICAL DEPARTMENT OF THE NAVY

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IN CHARGE

*Edited by*

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U. S. NAVY

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NAVY DEPARTMENT,
*Washington, March 20, 1907.*

The UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
*Acting Secretary.*

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Volume XI, No. 1, January, 1917.
Volume XI, No. 2, April, 1917.
Volume XI, No. 3, July, 1917.
Volume XI, No. 4, October, 1917.
Volume XII, No. 1, January, 1918.
Volume XII, No. 3, July, 1918.
Volume XIX, No. 3, September, 1923.
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# PREFACE

The United States Naval Medical Bulletin was first issued in April, 1907, as a means of supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, reports from various sources, historical essays, notes and comments on topics of medical interest, and reviews or notices of the latest published medical books.

The bureau extends an invitation to all medical officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the Bulletin of distinct originality and special merit, the Surgeon General of the Navy will send a letter of commendation to authors of papers of outstanding merit and will recommend that copies of such letters be made a part of the official records of the officers concerned.

The bureau does not necessarily undertake to indorse all views or opinions which may be expressed in the pages of this publication.

E. R. Stitt,
*Surgeon General, United States Navy.*

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# U. S. NAVAL MEDICAL BULLETIN

Vol. XXVI | April, 1928 | No. 2

## SPECIAL ARTICLES

### CHEMICAL WARFARE AND THE NAVAL MEDICAL OFFICER

By E. W. Brown, Commander, Medical Corps, United States Navy

#### INTRODUCTION

Chemical warfare is the latest development of war. So far as the United States is concerned it is only about 10 years old. While it was not employed by the various navies in the World War, it is practically certain that it will be utilized by naval forces in future conflicts. The success of gas warfare in Army operations in the World War, the ready commercial availability of chemical intermediates for the production of poison gases, and the danger of such surprise attacks in war have led the principal powers to accept the advent of chemical warfare and to incorporate it into the scheme of national defense for naval as well as land forces.

Within comparatively recent years there have developed the special fields of submarine and aviation medicine. The subject of diving in its physiological and medical aspects still presents important problems. Still another phase of activity has now been added to naval medicine, i. e., chemical warfare, and the naval medical officer is therefore confronted with the special problems involved in this new type of warfare. In order to meet the situation effectively, he must have a grasp of the essential fundamentals of the subject—not in a specialistic sense but in a broad, general way. He should at least have an organized view of the subject. The object of this paper is, therefore, to indicate in a concise way the fundamentals of naval chemical warfare in so far as the naval medical officer is involved. Basic principles only and not details are within the scope of this article.

#### THE VARIOUS ASPECTS OF THE SUBJECT

The various aspects of the subject before us will be considered under the following arrangement:

(1) Fundamental conceptions of gas warfare.
(2) Methods of naval chemical warfare.
(3) Edgewood Arsenal and the United States Navy.
(4) The chemical warfare agents.

(5) The toxicology of chemical warfare agents.
(6) The symptoms and treatment of gas casualties.
(7) Gas protection of the ship.
  (*1*) Individual protection.
    (*a*) The Navy gas mask.
    (*b*) The gas chamber.
    (*c*) Protective clothing.
  (*2*) Collective protection.
    (*a*) The prevention of access of gas to the battle stations of the ship.
    (*b*) The protection of matériel, food, and water supplies.
    (*c*) The degassing of the ship.
    (*d*) The degassing of clothes.
    (*e*) The organization for bathing procedure.
(8) Naval medical tactics in gas warfare.

The question arises, Why should the medical officer be interested in an offensive phase of the subject such as methods of naval chemical warfare? The answer to this is that an elementary knowledge of the tactical aspects of gas warfare is essential for the efficient recognition and handling of gas casualties at sea. He should not only know the type of gas or gases being used in an attack, but in addition the usual ways of putting such gases over.

He must also be conversant with the main features of individual and collective protection as part of the scheme of gas defense. While these matters would fall under the direction of the chemical warfare officer of the ship, the medical officer would be required to inspect the adequacy of the various antigas measures employed to assure himself that the sanitary integrity of the ship had been restored. His services as a consultant to the chemical warfare officer would fall within the scope of his duties.

### (1) FUNDAMENTAL CONCEPTIONS OF GAS WARFARE

There are certain fundamental conceptions of gas warfare that must be thoroughly understood if the medical officer is to develop plans for the management of gas casualties at sea or cooperate in the various forms of gas defense. A clear understanding of the term "gas," which is employed rather indiscriminately in chemical warfare, is essential. It includes all materials that are carried to the enemy by the air after their escape from cylinders, bombs, shell, or other containers. They may exist in the air in the form of true gases, smokes, finely pulverized solids, or even liquids. On the other hand, the word "gas" has nothing whatever to do with the physical condition of the material when in the shell or bombs or cylinders

before being released. In every such instance the gases are liquids or solids. When the containers are broken open the liquids or solids are volatilized or finely divided, either by the gas pressure or by the heat and force of the explosion.

There are some radical differences between gas warfare and artillery warfare which should be stressed. Thus, the action of gas is distributed in reference to space (1) and time to a tremendously greater extent than that of any other weapon employed in the field.

*Space.*—When a high-explosive shell or bomb explodes the danger is over after the last fragment strikes the ground. On the other hand, with a gas shell the casualty action only begins with the bursting of the shell. It must be remembered that the gas cloud from the shell or bomb drifts down wind and tends to produce casualties not only where the shell explodes but at a distance from it, at which place there would be no hazard from a high-explosive shell. With gas, therefore, you do not have to hit your man. Thus, by penetrating into the inclosed spaces of a ship, gas could produce results which would not be secured with the ordinary shell. Spaces of the ship, even remote from the point of impact of the gas shell, might fail to give adequate protection unless special devices were provided.

*Time.*—In the case of persistent gases, the area around the point of burst of the shell will be contaminated and will remain a hazard for periods which may sometimes last for weeks. Another significant point is that gas causes casualties in a different way from other weapons, in that there is, in many cases, a delayed effect, and the man who subsequently becomes a casualty may, at the moment he is gassed, be quite unaware of the fact. It is important that this delayed action should be thoroughly understood by all personnel in order that the effects may not be regarded as mysterious.

The employment of gas in the open has a direct relation to weather conditions. Obviously the use of gas would be impracticable in a rainstorm. However, a very light rain in the form of a mist is not prohibitive. The relation to wind conditions is vital. Thus, nonpersistent gases which are light, and therefore tend to diffuse and blow away rapidly, are comparatively ineffective in a wind over 12 miles per hour. Wind velocity, however, may often be affected by the target; e. g., a wind of 20 to 25 miles per hour in the open may be reduced to one of only 8 miles an hour or less in thick woods, thus inviting attack on such a target when it would be ineffective on a more open one.

Gas differs in yet another way from any other weapon used in naval warfare in that the casualties produced differ according to the type of gaseous weapon used. When a bullet or shell is fired, its casualty-producing ability depends simply on whether or not a hit is made and the velocity and ballistic peculiarities of the missile.

On the other hand, chemical warfare agents depend upon the phsiologic effects which they produce for their tactical value. One group of agents may be primarily lethal, another may only produce temporary casualties of limited duration, another, prolonged casualties with little mortality, and still a fourth may be not toxic but only harassing by forcing wearing of the gas mask, thereby reducing efficiency to a serious extent. As Gen. Amos A. Fries (2) has so graphically expressed it: "In chemical warefare we may temper the blow by the choice of weapon"; thereby presenting a sharp contrast to ordinary weapons.

Again quoting General Fries (3): "Gas is a universal weapon, applicable to every arm and every sort of action. Since we can choose gases that are either liquid or solid, that are irritating or highly poisonous, that are visible or invisible, that persist for days or pass with the wind, we have a weapon applicable to every act of war."

### (2) METHODS OF NAVAL CHEMICAL WARFARE

Chemical warfare was not utilized by the navies in the World War, apparently for two reasons; one, that the opposing forces did not desire to be responsible for the advent of poison-gas warfare at sea; the other, that both sides had serious misgivings as to the value of chemical weapons as compared with the older methods. The effects of a direct hit by a shell, a torpedo, or a bomb loaded with high explosive were known. The results to be looked for from the use of chemical agents at sea were uncertain and the replacement of established weapons in favor of new and untried methods was not considered justified. The question therefore naturally arises—By what means of attack could chemical warfare be carried on at sea? Three general methods must be considered: (1) Aircraft, (2) passive gas cloud attacks, and (3) gas shell attacks.

*Projection from aircraft.*—This is the method of outstanding promise from the naval standpoint. Since the World War astounding progress has been made not only in aviation but in the tactics of the projection of chemical agents from aircraft. Generally speaking, nonpersistent chemical agents do not appear to have much application at sea on account of the relatively large quantities of these materials that would have to be carried. The same number of enemy casualties can be caused by much smaller quantities of persistent chemical agents.

Let us take mustard gas in this connection as an example of the most important persistent type. The use of mustard—a liquid under ordinary conditions—by planes is bound to play an important part in any future naval warfare. The mustard gas can be dropped in chemical bombs with or without combination with high explosive.

Mustard may also be sprinkled or sprayed from planes at comparatively high altitudes. By this means the liquid is made to fall like rain from a cloud. In this way the highly vesicant liquid may be actually brought in contact with personnel occupying the open stations of a battleship, such as the fighting tops, antiaircraft platforms, etc. Light, high-speed airplanes flying at lower altitudes can actually atomize such a liquid as mustard, the liquid falling as a mist, thus securing an enormously increased effect on the target.

The effectiveness of laying screening smokes by aircraft in naval tactics is well established. It must be remembered, however, that poisonous smokes may also be projected, either alone or camouflaged by screening smokes.

*Passive cloud attacks.*—By this means the chemical agent is released on our own ships in such a way as to allow the wind to carry it to the enemy's vessels. Gas cloud attacks are materially dependent upon the direction of the wind. The most promising technique is the dispersion of poisonous smokes with or without screening smokes from the stacks of vessels—more particularly destroyers. Boxes and cylinders installed aboard ship could be utilized for the evolution of toxic chemical agents in clouds. Floating smoke boxes could be filled with poisonous chemical materials and released to windward of the enemy.

*Gas shell attacks.*—The same arguments hold against using nonpersistent agents in gas shell as were advanced against their use by aircraft. The replacing of a small proportion of the high explosive of the present armor-piercing shell may prove to be entirely feasible and desirable. All hits which penetrated would release, in addition to the general demolition effect, a certain amount of toxic agent. This would not only render the particular demolished compartments uninhabitable and also unapproachable without protection, but the gas would be expected to infiltrate into adjacent compartments through splinter holes, communication doors, voice tubes, and ventilation systems. Gas shell would be readily adaptable to the objectives of the secondary battery of a battleship.

Finally it must be borne in mind that in chemical warfare as in other forms of combat the surprise effect is outstanding. This may be accomplished in two directions; i. e., (1) by the development of new chemical agents, and (2) by new or more effective methods of technique for the projection of the present types of chemical agents at sea.

### (3) EDGEWOOD ARSENAL AND THE UNITED STATES NAVY

In view of the fact that virtually all of the chemical warfare activities of the Navy are centered at Edgewood Arsenal, naval medical officers should have a clear conception as to the scope of its

activities. The necessity for such an establishment will first be indicated.

Edgewood Arsenal, at Edgewood, Md., is the headquarters for the research, manufacturing, and training activities of the Chemical Warfare Service of the United States Army. Research and development are controlled by the commanding officer through a technical director, who coordinates the work of three research divisions; i. e., the Chemical, Mechanical, and Medical Research Divisions. The technical director plans the lines of investigation and research to be followed according to the policies and needs of the Army and the Navy as directed by the Chief, Chemical Warfare Service.

In chemical warfare, as in other forms of warfare, there is the unending competition between offense and defense. It is like the familiar duel of the naval gun and armor—at one selected moment the offense is in the lead; at another selected moment the defense has the advantage. For instance, at one time the gas mask and protective clothing may give adequate protection against any concentration of gas which may be encountered in a naval gas offensive; that is, the defense is superior to the offense. On the other hand, a new gas, or even a new method of projection of an old gas, may at any time render this protection obsolete, a situation in which the offense has the upper hand. This condition of affairs has already arisen since the World War, and in each instance an improvement in protective devices has successfully met the situation.

Hence the imperative need for constant progressive research in chemical warfare. While it is impossible to be certain that the enemy will not use a gas which is unknown to us and against which we have no protection, nevertheless new chemical compounds for offensive use are being continuously developed and new defensive appliances evolved as necessary. The longer this type of work is continued, the less likely will it be that an enemy will use a gas unknown to us and against which we have no protection.

Since 1922 a naval unit has been maintained at Edgewood Arsenal in order to establish a close liaison with the Chemical Warfare Service of the Army. Certain bureaus of the Navy Department have allotted funds from year to year and a systematic combined Army and Navy research, development, and production program has been in progress. The Chemical Warfare School at Edgewood Arsenal is the special service school of this branch of the Army, and officers, both line and medical, and enlisted men of the Army, Navy, and Marine Corps are here assigned instruction in chemical warfare. There is one naval medical officer representing the Bureau of Medicine and Surgery assigned to the Medical Research Division. Among

other production activities for the Navy is the manufacture of all gas masks of the various types at Edgewood Arsenal.

### (4) THE CHEMICAL-WARFARE AGENTS

It may be of interest in this connection to point out the following requirements which a chemical compound must satisfy to be adapted to chemical warfare use. In chemical warfare nomenclature the chemical compounds are ordinarily designated "agents."

(1) It must first of all be highly toxic. This indicates that it must reach such a concentration when projected in the field as to be either lethal or at least casualty producing. The gas must also be one which, while fatal in high concentrations, will cause more or less serious injury in concentrations far below that necessary to kill.

(2) It must be readily manufactured in large quantities. Obviously, a chemical might prove to be tremendously toxic even in low concentrations under laboratory conditions, but its production on a large scale might be impracticable. In fact, this situation has repeatedly arisen in chemical warfare research.

(3) It must be readily compressible to a liquid and yet be more or less easily volatilized when the pressure is released. Gases could hardly be transported as such in the field. Thus, carbon monoxide is a type of gas which, although highly toxic, can not be readily liquefied and is therefore not suited to gas-warfare use. As will be referred to later, certain of the standard chemical warfare agents are liquids or solids in the natural state.

(4) It must have a considerably higher density than that of air. The heavier the gas, the more slowly will it dissipate by diffusion into the surrounding atmosphere. It will tend to settle down into the lowest points over which it is spread and escape only through diffusion upward into the air. If the gas be lighter than air it will not only travel away by diffusion but also cause upward currents that mechanically mix it with the surrounding air.

(5) Lastly, it should be comparatively nonreactive in being relatively stable against moisture and other chemicals.

The chemical warfare agents which are standard at the present time are classified in the following table (4). It will be noted that they are classified according to physical state, tactical uses, physiological effects, and persistency or nonpersistency, and that the various agents are designated by the chemical name, common name, and Chemical Warfare Service symbol. The use of the last named is standard practice as a matter of convenience in the Chemical Warfare Service.

*Classification of chemical warfare agents*

| | | Chemical Warfare Service symbol | Common name | Chemical name |
|---|---|---|---|---|
| 1. Physical (ordinary state temperatures) | A. Gases | Cl | Chlorine | Chlorine. |
| | | CG | Phosgene | Carbonylchloride. |
| | B. Liquids | HS | Mustard | Dichlorethylsulphide. |
| | | M1 | Lewisite | Chlorvinyldichlorarsine. |
| | | PS | Chlorpicrin | Trichlornitromethane. |
| | | CA | Brombenzylcyanide | Same. |
| | | CC | Crude oil | Mixture. |
| | | FM | Titanium tetrachloride | Same. |
| | C. Solids | DA | Diphenylchlorarsine | Same. |
| | | DM | Diphenylaminechlorarsine | Same. |
| | | CN | Chloracetophenone | Same. |
| | | HC | Hexachlorethane | Same. |
| | | P | Phosphorus | Same. |
| 2. Tactical use | A. Lethal agents: Cl, CG, PS. | | | |
| | B. Severe direct casualty agents: HS, Ml, CG, Cl, PS, WP. | | | |
| | C. Temporary casualty agents: DA, DM. | | | |
| | D. Harassing agents: CN, CA. | | | |
| | E. Screening agents: WP, FM, HC, CC. | | | |
| 3. Physiological effects | A. Lung irritants: Cl, CG, PS. | | | |
| | B. Vesicants: HS, Ml. | | | |
| | C. Lachrymators: CA, CN. | | | |
| | D. Sensory irritants: DA, DM. | | | |
| | E. Screening smokes: HC, P, FM, CC. | | | |
| 4. Persistency | A. Persistent chemical agents: HS, Ml, CA. | | | |
| | B. Semipersistent: PS. | | | |
| | C. Nonpersistent: All others. | | | |

There are four compounds in the above table classified as screening agents and employed for the production of screening smokes which are entirely harmless.

As many as 25 different chemical agents were employed by the contending forces during the World War, but most of these substances were gradually eliminated for such reasons as instability, inferior toxicity, nonpersistency, excessive cost of production, etc. Of the 9 toxic compounds in the above table, 3 were not utilized in the World War; i. e., lewisite, chloracetophenone, and diphenylaminechlorarsine. These 3 agents were all known before the end of the conflict but were not manufactured on a large scale in time for field use before the armistice.

It will be noted that 2 of the compounds in the table are gases in the natural state, 6 are liquids, and 5 are solids. It will also be seen that chemical warfare agents are classified as to persistency or nonpersistency. This is known as the tactical classification. The term "persistency" should be defined. An agent is persistent, if 10 minutes after its release in the open, under conditions which are favorable for the use of the chemical, there is sufficient remaining at the point of release to require protection for personnel in that vicinity. If there is not enough of the agent at the point of release at the end of 10 minutes to call for any protective measure, it is considered as

nonpersistent. Persistency depends chiefly upon the rapidity of evaporation of the agent, which in turn depends roughly upon the boiling point of the agent, as modified by weather conditions and the nature of the terrain.

Nonpersistent agents are, generally speaking, gases at ordinary temperatures and, when released from containers, are rather rapidly carried away by the wind and air currents. On the other hand, persistent agents are only slightly volatile agents and, when scattered on the ground, give off their vapors so slowly that the area so treated may remain dangerously contaminated for a long time. Agents of the persistent group are especially useful in harassing an enemy, thereby breaking down his morale and preventing him from attacking over or occupying areas drenched with them. The persistency of the various agents ranges from one to seven days or even longer.

The above table also classifies the chemical warfare agents according to their physiological effects. This classification, of course, depends on the particular structure of the organism which is characteristically acted on by the gas and is as follows:

(1) *Lung irritants.*—Compounds, represented by chlorine, phosgene, and chlorpicrin, which, on inhalation, produce lesions of the respiratory tract.

(2) *Vesicants.*—Compounds, represented by mustard and lewisite, which attack both the respiratory tract and the skin. In fact, every part of the body making contact with the liquid or the vapor of the agent is involved.

(3) *Lachrymators.*—Compounds, such as chloracetophenone and brombenzylcyanide, which can cause a temporary blindness from pain in the eyes and severe lachrymation. No other effects are ordinarily produced except slight burning of the skin. These are not considered as toxic gases.

(4) *Sensory irritants.*—These compounds, represented by diphenylchlorarsine and diphenylaminechlorarsine, are solids and are released by thermal methods in the form of toxic smokes. They first cause irritation followed by excruciating pain in the nose, throat, and chest, associated with sneezing, coughing, and vomiting. These casualties are severe but temporary; after effects are very rare.

There is some overlapping of physiological effects in the above grouping. Thus a lachrymator may act as a lung irritant if breathed in sufficient quantity under laboratory conditions. Chlorpicrin has a powerful lachrymatory action in addition to its lung-irritant effects. Diphenylchlorarsine has a vesicant action on the skin in contact with the concentrated material. However, the above classification is entirely satisfactory for ordinary purposes.

*The adaptation of gases to the Navy.*—Of the above list of standard chemical agents of the Chemical Warfare Service of the Army, what

compounds would probably be adopted to the Navy? Such knowledge should aid the medical officer in making an early diagnosis during a gas attack.

It appears probable that the lung irritants would not be used. The greater number of them are nonpersistent and therefore if used prior to an engagement would not contaminate the ship for any length of time. As their action is slightly delayed, they would not be of any great value during an engagement. The use of nonpersistent agents in chemical shell might be of value with the secondary battery. The medical officer for this reason alone should be prepared to receive lung-irritant casualties.

Vesicants of the type of mustard involve such a long delay that they would probably not be of value during an engagement, but could be projected to advantage on ships many hours prior to a fleet action. On the other hand, a vesicant of the lewisite type, with its comparatively short incubation period, probably would be utilized along with high-explosive shells.

Persistent lachrymators could be utilized during a fleet action to blind or harass the enemy by forcing him to mask. Nonpersistent compounds of this class would be of little value. CA and CN would be adapted. It should be stated that CN may induce a persistent effect depending on the technique of projection.

The sensory irritants offer promise of efficient naval use, but persistency would be demanded. DA and DM put off as toxic smokes from destroyer stacks promise to be of enormous value in an engagement. Even after settling out on the decks and bulkheads these compounds would later be raised as dust clouds by the movements of personnel.

What would be the ideal gas for a naval attack? It is generally conceded that a powerful vesicant acting instantly would answer the requirements. Summing up, it may be said that all plans for future naval warfare must include the threat from mustard, lachrymators, and toxic smokes.

### (5) THE TOXICOLOGY OF THE CHEMICAL-WARFARE AGENTS

The mechanism of action of the chemical-warfare agents will be concisely pointed out, only the outstanding features being stressed.

*The lung irritants.*—These compounds—i. e., chlorine, phosgene, and chlorpicrin—act by damaging or destroying the mucous membrane lining the respiratory passages, and interfere with the supply of oxygen to the blood by traumatism of the lung alveoli. The action of the individual lung irritants shows some differences but, in general, they are quite similar. Immediate symptoms of irritation of the eyes, nose, throat, and chest are produced. The injured lung

reacts, tending to fill up with fluid from the blood plasma. This gradual production of lung edema results in a decrease in the respiratory surface area of the lungs and consequently a reduction in the amount of oxygen that would normally have access to the blood stream.

Concentration of the blood plasma takes place, with an accompanying increase in the viscosity. The circulation is interfered with, as the heart can not force the concentrated blood through the blood vessels at the normal rate. A vicious circle is thus established. The blood, owing to its increased viscosity, can not circulate so rapidly, and the supply of oxygen to the tissues is still further reduced. At the same time, the heart itself, in common with the other organs and tissues, is suffering from anoxemia. The heart in urgent cases ultimately dilates and circulatory collapse occurs, leading to a fatal issue.

There are certain differences in the locus of action of the lung irritants. Thus, chlorine attacks more vigorously the moist mucous membrane lining the upper portions of the respiratory tract. It does not damage the lower and more vital portions as severely as phosgene and chlorpicrin. With phosgene the situation is quite different. It is readily split up by moisture into HC and $CO_2$. When breathed, little decomposition takes place until the gas reaches the lower portion of the lungs; there, in the smaller bronchioles. and alveoli, it comes in contact with sufficient water for hydrolysis. The damage done by phosgene is, in all probability, due entirely to the hydrochloric acid liberated in the lung tissue. It is assumed that most of this decomposition takes place very gradually and this, in all probability, accounts for the delayed appearance of symptoms which is so characteristic of phosgene poisoning and differentiates it from chlorine and chlorpicrin.

Chlorpicrin is a rather stable compound and therefore does not decompose readily. It does not unite directly with the mucous membrane lining the respiratory tract, as is the case with chlorine, nor is it absorbed in the lower portion of the respiratory tract and there decomposed, liberating an acid, as in the case of phosgene. The principle action of chlorpicrin appears to take place in the medium-sized and smaller bronchi. It thus occupies an intermediate position as compared with chlorine and phosgene.

Summarizing, it is found that edema is the most characteristic symptom of the lung irritants. It is greatest in the case of phosgene, somewhat less with chlorpicrin, and least with chlorine. When we consider that the upper portion of the respiratory tract is merely an air passage to the more vital portion, the alveoli, we would expect to find that chlorine is not so toxic as phosgene, which attacks prin-

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cipally the lower portion. We would expect chlorpicrin, which attacks the middle portion, to fall somewhere between chlorine and phosgene in toxicity. Experimentally we find this to be the case.

*The vesicants.*—The vesicant compounds are characterized by their property of penetrating the intact skin fairly rapidly and producing severe burns. There are two types of such vesicants which are of special interest. The first type is represented by mustard gas. The second by lewisite, which is an organic arsenical compound. Mustard produces a vesicant action without inducing systemic poisoning; after absorption by the skin it is decomposed into harmless compounds, so far as any general effect is concerned.

Mustard behaves as a chemical irritant in both the liquid and vapor phases, producing a local burn on any part of the human body with which it comes in contact. The parts most affected are naturally those exposed without any clothing, such as the face and hands; but the areas which are thin and moist—i. e., the axilla, groins, genitalia, and the inner parts of the thighs are very sensitive to mustard.

The mechanism of action of mustard gas has not yet been established. During the World War the Chemical Warfare Service advanced the theory that mustard gas penetrated the cell wall rapidly and was there hydrolized, liberating free hydrochloric acid, which in turn directly caused the death of the cell. The German Chemical Warfare Service did not concur in this theory, but suggested that mustard was oxidized in the body to mustard sulphone, which in turn produced the toxic action. Another theory which has been proposed within the last few years by the United States Chemical Warfare Service is that mustard gas penetrates the cell, and there combines with one or more of the amino constituents of the cell, resulting in its gradual death. The development of an effective antidote for mustard depends on the demonstration of the chemical reactions which mustard undergoes in the cell.

*Sensitivity.*—There is a curious variation in the sensitivity of men to mustard. The variation between a very sensitive and a highly resistant individual may be more than one hundred times. The results of tests made with large numbers of men during the World War showed that about 2 per cent were very sensitive, 7.5 per cent sensitive, 68.6 per cent average, and 21.9 per cent resistant. It is of significance that of a large number of negroes examined, 85 per cent were resistant. It is entirely possible that in future war the mustard sensitivity test may be applied to military personnel in order to eliminate ultrasensitive individuals from such details as the cleaning up of vesicants, employment in mustard plants, etc.

*Lewisite.*—This may be taken as typical of the arsenical vesicants. The vapor is about as toxic as mustard by inhalation, but is a more severe vesicant. The clinical course of its action on the skin is more extensive and there is less delayed action than in the case of mustard. Burns from the vapor phase of lewisite begin to develop within 1 to 3 hours, depending on the concentration; from the liquid phase, within 15 minutes. The appearance of a burn from lewisite is somewhat different from that of mustard, in that the lewisite lesions are usually gray in color and more sharply outlined. Mustard gas, after producing its vesicant action on the skin, is broken up and excreted as a nontoxic product. Lewisite, on the other hand, is broken up into toxic arsenical compounds as poisonous as itself, which produce acute or chronic arsenical poisoning, often leading to a fatal issue. The mechanism of action of lewisite has not yet been solved and is one of the large outstanding problems of the Chemical Warfare Service.

*Lachrymators.*—These compounds, represented by chloracetophenone and brombenzylcyanide, have a special action on the nerves of the eye and produce irritation and blinding tears in concentrations which may not affect the respiratory system or the skin. Chloracetophenone induces mild skin irritation in hot weather, which, however, disappears within 24 hours without leaving any after effects. The lachrymators are not regarded as toxic gases in view of the fact that in field concentrations their effects are almost entirely confined to the eyes. The mechanism of action has not been determined.

*The sensory irritants.*—The sensory irritants are all substitution products of arsine, the hydrogen being replaced by chlorine, cyanide, phenyl, or ethyl radicals in the various compounds. These chemical changes, to a large extent, mask the ordinary toxic properties of arsenic, the agents showing an irritating action on the sensory nerve endings in the eyes, nose, and throat even in very minute concentration. Here again the exact mechanism of action has not been demonstrated.

The compounds of special interest are diphenylchlorarsine, diphenylaminechlorarsine, and diphenylcyanarsine. These compounds are effective in approximately the same concentration. Diphenylaminechlorarsine is not quite so irritating as the other two compounds, but the symptoms produced last much longer. It is possible to set up a concentration of diphenylaminechlorarsine which will later incapacitate a man without his knowledge of exposure at the time. Diphenylchlorarsine and diphenylcyanarsine are more irritant immediately.

*The relative toxicity of chemical-warfare agents.*—The comparative toxicity of the lung irritants and vesicants by inhalation is compared in the following table for 30-minute periods of exposure:

| | Ounces per 1,000 cubic feet |
|---|---|
| Chlorine | 3.0 |
| Chlorpicrin | .8 |
| Phosgene | .3 |
| Mustard | .07 |
| Lewisite | .05 |

It will be noted that the unit of toxicity is taken as ounces per 1,000 cubic feet. Phosgene is seen to be ten times as toxic and mustard nearly fifty times as toxic as chlorine. Mustard is four to five times as poisonous as phosgene. The lachrymators will act within a few minutes in a concentration of 0.0003 ounce per 1,000 cubic feet, and 0.01 ounce per 1,000 cubic feet will produce an intolerable irritation resulting in temporary blindness. Diphenylchlorarsine and diphenylcyanarsine in concentrations as low as 0.001 ounce per 1,000 cubic feet bring about intolerable irritation after 10 minutes' exposure.

(6) THE SYMPTOMS AND TREATMENT OF GAS CASUALTIES

It has already been pointed out that the symptoms of gas casualties have a direct relation to the tactical use of the gas in question. This is brought out in the table of classification on page 224 under "Tactical use." It will be observed that chlorine, phosgene, and chlorpicrin are employed as lethal agents primarily and that mustard and lewisite are utilized as severe direct casualty agents; that diphenylchlorarsine and diphenylaminechlorarsine are temporary casualty agents. Chloracetophenone and brombenzylcyanide are harassing gases; that is, they compel masking. It will be seen that the military objective may be gained with gas with a loss of life relatively small as contrasted with gunfire. With gas you have a weapon whose effectiveness you can control, and gas warfare, therefore, can be made as humane as the nation using it desires. This is not true of other weapons.

An attempt will be made to bring out the salient features rather than a routine description of symptoms. The general trend of the symptomatology can be predicted from the toxicological action already outlined.

*The lung irritants.*—In a broad general way the symptoms are quite similar for all three of the lung irritants. We have already seen, however, that with phosgene there may be a prolonged delay in the development of serious symptoms which is not met with in the case of chlorine or chlorpicrin. This fact, which will be discussed later, has a significant bearing on the early handling of phosgene casualties.

The first symptoms of the lung irritants as a group are smarting of the eyes; irritation and burning in the nose, throat, and trachea;

coughing; and a sense of constriction of the chest associated with coughing and dyspnœa.

*The pulmonary edema.*—All of the more serious cases progress to the stage of pulmonary edema which, in general, is responsible for the outcome in the fatal cases. As would be expected, the general features of this condition are practically identical for all three lung irritants.

*Blue stage asphyxia.*—This term was applied in the World War to the stage of lung edema when cyanosis was well developed, but prior to the signs of failing circulation. As the edema develops in the lungs, the breathing becomes more rapid and panting and of a characteristically shallow type. The ears, lips, and, progressively, the entire face assume a cyanotic, bluish-red tint which may deepen to the intense violet of advanced cyanosis, and there may be visible distention of the superficial veins of the face, neck, or chest. There are copious frothy sputum, frequent cough, with respirations of 40 to 48 per minute, elevated temperature, and a full, strong pulse in the neighborhood of 100. This condition is most frequently seen on the second day after gassing.

*Gray stage asphyxia.*—This term was applied to the stage of circulatory collapse. The patient may recover from blue stage asphyxia or he may pass into the gray stage as the result of a dilated and failing heart. The color becomes an ashen gray, the expression anxious and staring, and respiratory difficulty is shown by the strained effect of the muscles around the nostrils. There is intense oxygen want. The breathing is markedly hurried and shallow and a rapid running pulse of 130 or over develops. The prognosis is distinctly bad in this stage and the outcome is usually determined within 72 hours of the time the victim was gassed. Apparent recovery from gray stage asphyxia may be succeeded by a severe or even fatal broncho-pneumonia.

*The delayed action of phosgene.*—The mode of onset in phosgene poisoning may be acute, with immediate sensory irritation of the respiratory passages, with catching of the breath, coughing, and sensations of tightness, constriction, and pain in the chest. On the other hand, an insidious or delayed onset was frequently observed in the World War. As illustrative of this delayed action the following case history (5) is presented:

A chemist was working in an English laboratory on the preparation of a new chemical compound on February 3, 1917. A bottle of phosgene, required for this synthesis, burst on the laboratory table at 1 p. m. A yellowish cloud was seen by a second person to go up close to the face of the chemist, who exclaimed, "I'm gassed," and both hurried out of the room. Outside, the patient sat down on a chair, looking pale and coughing slightly. At 2.30 p. m. he was in bed in a hospital, to which he had been taken in an automobile, having been

at rest since the accident. He was hardly coughing at all; pulse normal; no distress or anxiety and talking freely to friends for over an hour. At 5.30 p. m. there was a sudden change. Coughing and frothy expectoration began and the patient became bluish about the lips. His condition now rapidly deteriorated. His face became a gray ashen color; never purple. He died at 6.50 p. m. without any great struggle for breath.

This case was remarkable in that symptoms of irritation were very slight at the onset; there was a delay of at least four hours before serious signs appeared; and the development of fatal edema took little more than an hour's time.

Another situation (6) showing the delayed action of phosgene follows:

During the night of June 5, 1917, on the western front, two companies of the Seaforth Highlanders were employed in pick and shovel work for the consolidation of trenches. At 3 a. m. they were suddenly subjected, while digging, to an accurate fire of enemy gas bombs, probably phosgene, from light trench mortars.

The men were marched back some distance, only three having complained of any symptoms. About 5 a. m. breakfast was served, and after the meal a number of men vomited and reported difficulty in breathing. Several men after a short sleep awoke with similar symptoms. One sergeant died soon after breakfast and another who was recording the names of the sick suddenly suffered fatal collapse. There were 91 casualties, of which 18 died. These cases were probably caused by pure phosgene, and their slight initial features with rapid and fatal development after a delay of three to four hours are closely parallel with those of the chemist in England above referred to.

*The treatment of lung irritant casualties.*—The first-aid measures are absolute rest, warmth, and loosening or removal of the clothing. The basic principles of treatment are to combat the pulmonary edema and associated anoxemia. Oxygen should be administered on the first signs of cyanosis. Venesection in the amount of 500 cubic centimeters of blood is carried out early, in order to stimulate reabsorption of edematous fluid from the lung into the circulation. The intravenous injection of a glucose-agar solution in animals has given strikingly favorable results. The introduction of such a colloidal solution tends to reabsorb fluid from the edematous area into the circulating blood.

*Symptoms of the vesicants.*—Mustard was the outstanding chemical warfare agent of the World War. Although not put over by the Germans until July, 1917, it produced 77.5 per cent of the total gas casualties in the British Army, this figure being based on data in which the causative gases were known. Of 36,965 gas casualties in the American Expeditionary Forces, 27,711, or 75 per cent, were due to mustard. After the introduction of mustard, the lung irritant and other gases took a subordinate position.

The main features of the symptomatology from mustard vapor are as follows:

Delay of irritant effect for from 2 to 48 hours.

Conjunctivitis to an extreme degree.

Erythema of exposed surfaces of the skin and of the moist protected areas, followed by blistering, excoriation, and brown staining.

Inflammation of the trachea and bronchi, with necrosis of the mucous membrance, and the development of secondary bronchitis or broncho-pneumonia.

On exposure to moderate concentrations of mustard vapor nothing is noticed at first except the faint garlic odor. After the lapse of two or three hours symptoms will ordinarily begin to appear and subsequently progress with some rapidity. The eyes begin to smart and lachrymate and a severe and painful conjunctivitis develops. In fact, the eyes are more sensitive to mustard than the skin. The nose then begins to run with thin mucus, as from a severe cold in the head, and sneezing is frequent. Shortly subsequent to the rhinitis, the throat feels dry and burning, the voice becomes hoarse, and a harsh, dry cough appears.

Inflammation of the skin now shows itself, gradually progressing from a dusky red erythema with intense itching to the formation of small vesicles which quickly coalesce to form large blisters. There is practically no pain associated with the burns from mustard. This is in marked contrast to the immediate burning pain resulting from the ordinary corrosive chemicals, as the strong acids and alkalies. The skin presents all stages of burns with mustard, from primary erythema up to the final stage of a deep burn with necrosis and sloughing of the tissues. The last-named condition, of course, is only seen when life has been maintained for a considerable period. Ordinarily, in the fatal cases resulting from lesions of the lungs, the skin lesions will not have proceeded beyond the stage of vesication and stripping of the epidermal layer.

The main pathological lesions which cause death are as follows: An acute inflammation of the air passages from the larynx downward, followed by desquamation of the mucous lining, with a remarkable false membrane formation. This membrane, in addition to the actual destructive effect it produces, invites secondary infection. An acute bronchitis is superadded, leading to collapse of lung tissue and then to broncho-pneumonia, which is usually the direct cause of death in mustard poisoning. Only in the rarest situations is there any mortality from even very extensive lesions of the skin.

When liquid mustard is brought in contact with the skin the lesions produced are quite similar to those induced by the vapor, except that

the course proceeds more rapidly. Irritant effects are usually evident within one to two hours and blistering may be looked for in eight to ten hours.

*The delayed action of mustard.*—The delayed and insidious action is a striking characteristic of this agent. This is stressed in the following instances: Reed (7) exposed himself in his shirt sleeves in a chamber for 45 minutes to a concentration of 0.0012 ounce of mustard per 1,000 cubic feet. He was barely able to recognize the presence of mustard by the sense of smell. There was practically nothing noticed while in the chamber or for 5¼ hours following. Then eye symptoms developed, until at a period 12 hours after exposure he was practically blinded, and remained so for a number of hours. The pain in the eyes was so severe that he was unable to sleep for 30 hours. The conjunctivitis was followed by a rhinitis.

No skin symptoms were evident during the first two days, but on the third day a marked erythema had appeared on the neck, shoulders, upper arms, and trunk as far as the waist line. The discomfort was almost intolerable. No symptoms of pulmonary involvement were present at any time. The skin symptoms remained unchanged for seven days, and three weeks were required for the conjunctivitis to clear up.

Reed (7) also demonstrated that mustard may be dangerous in even lower concentrations. Of 17 men exposed to 0.0005 ounce per 1,000 cubic feet from 10 to 45 minutes, 6 showed a definite conjunctivitis and 1 skin effects. Of 13 men subjected to a concentration of 0.0001 ounce per 1,000 cubic feet for 10 to 30 minutes, 3 reported distinct conjunctivitis. Another group of 13 subjects at concentrations of 0.00047 to 0.00058 ounce per 1,000 cubic feet showed 7 instances of conjunctivitis and 3 distinct skin burns. The delay in the appearance of skin symptoms varied from 1 to 3 days in the various tests. The fact seems to be etablished that mustard vapor is dangerous in concentrations less than 0.001 ounce per 1,000 cubic feet and that at a concentration even as low as 0.0002 ounce per 1,000 cubic feet for several hours may seriously involve the eyes and probably affect the skin.

*The symptoms of lewisite.*—Lewisite stands in sharp contrast to mustard in certain respects. While the objective effects of lewisite vapor on the skin are quite similar to mustard, the incubation period is much shorter with lewisite and there is immediate violent irritation to the respiratory mucous membranes on inhalation. With mustard there is no sensory reaction of the mucous membrane for one or more hours. Splashing of the skin with liquid lewisite produces a sharply defined gray splotch, appearing in approximately 15 minutes. Under similar circumstances mustard would lead to an erythema, but not in less than 1 to 2 hours.

It must be remembered that lewisite is of doubtful value in the gaseous phase in view of the fact that it is rapidly hydrolyzed by atmospheric moisture. It is questionable if an effective concentration could be maintained for a sufficient length of time. On the other hand, lewisite will prove of great value as a casualty-producing agent if the liquid can be brought in direct contact with personnel. The sprinkling of this agent from aircraft appears very promising. If the lewisite burn is extensive, arsenic will be absorbed from the decomposition products in the skin and the clinical features of arsenical poisoning, such as destruction of red blood cells, the development of anemia and jaundice, and peripheral neuritis will follow. It is estimated that the application of 0.02 cubic centimeter of lewisite per square centimeter per kilo body weight is a fatal dose for a man. Such a dose would be approximately 1.4 cubic centimeters spread over the skin of a man of average weight.

*The treatment of casualties from mustard.*—(1) *Prophylactic.*—The first step in the protection of the skin against the effects of contact with mustard is prompt and complete removal. Mustard enters the skin very quickly and, unless its removal is accomplished without loss of time, a serious burn will surely result.

The first essential is to prevent further exposure to mustard from contaminated clothing or equipment, which would be a source of danger both to the casualty and to those attending him. This should be removed at the earliest possible moment.

Bathing procedure: A bathing procedure, if possible, using shower baths with hot water and soap, is organized for all personnel suspected of contamination with mustard vapor. The eyes are prophylactically treated with a boric acid lotion. This is followed by the issue of fresh clothing. Mobile bathing units for this purpose were assigned to Army divisions on the western front toward the end of the World War. If the patient has been exposed only to mustard vapor the bathing procedure and change of clothing will usually be effective if carried out within 30 minutes.

*Removal of liquid mustard:* Liquid mustard is removed from the skin by sponging with an organic solvent, such as kerosene or carbon tetrachloride, in which it is soluble. If the mustard has been in contact with the skin for more than one or two minutes, it will be absolutely essential that the area be treated with fresh portions of the organic solvent every two or three minutes and massaged with the hand continuously after each application, the entire operation continuing for 30 minutes. This technique will prevent blistering if commenced within 20 minutes after exposure to the mustard.

(2) *Definitive treatment.*—The objectives are to relieve the intolerable itching and if possible prevent infection which is responsible

for the protracted hospitalization of these cases. There is no specific treatment for either the skin or pulmonary lesions.

*The treatment of casualties from lewisite.*—The most suitable treatment for the vapor burns of lewisite is the use of a ferric hydroxide paste which consists of a suspension of fine colloidal nongranular ferric hydroxide in pure glycerin. This paste is applied profusely over the burn and covered with an impervious dressing.

Promptness in removing liquid lewisite from contact with the skin is even more imperative than in the case of mustard. Lewisite is completely destroyed by the application of a 5 per cent solution of sodium hydroxide, which must then be quickly removed by washing with soap and water. This method will undoubtedly save life by preventing the absorption of a lethal quantity of arsenic through the skin after extensive exposure. A more effective procedure, which has proved successful with animals, is excision of the skin of the burned area and adjacent region. This may be regarded as a life-saving procedure for a period as long as 24 hours after the burn has been received, provided the lewisite has been already neutralized with the sodium solution.

*The symptoms of the lachrymators.*—With such concentrations as are practicable in the field the symptoms are confined to the eyes, with perhaps slight burning of the skin. There are sensations of smarting and burning with lachrymation. This symptom may become so intolerable that there is temporary blindness. Following exposure there will be some discomfort, but this is of short duration except in the case of exposure to very high concentrations or lower percentages for prolonged periods. Even the most severe casualties will reach normal within 24 hours.

The treatment is extremely simple. If the patient stands facing into the wind, even severe cases will clear up in 20 to 30 minutes. The eyes should be washed with a boric acid or soda bicarbonate solution.

*The symptoms of the sensory irritants.*—These compounds produce severe temporary casualties. When men are subjected to the toxic action of minute amounts of diphenylchlorarsine, the following effects are observed in the order of their appearance: Irritation of the nose and throat, with repeated sneezing; irritation of the eyes, with lachrymation; irritation of the chest, with a growing feeling of suffocation; excessive nasal secretion; ropy saliva; and nausea. On prolonged exposure, aching pains in the stomach and numbness of the limbs may appear. The numbness may later change to extremely sharp pains. Following exposure the following symptoms develop: A slight vertigo immediately after exposure; profuse salivation; intense burning in the nose and throat; nausea, headache, and pain

in the teeth and jaws. The burning in the nose and throat persists after all other effects have disappeared. Ordinarily, all of these symptoms, which are actually delayed effects, are mild.

The period of incapacity after even a rather high concentration of diphenylchlorarsine is short, severe effects rarely continuing longer than 30 minutes to 3 hours, and is caused by nausea, dizziness, and headache. Headache and a feeling of depression may persist for as long as 12 hours, but the casualties are able to be up and about. Sensory irritant cases are not classed as hospital casualties. As a rule, after a few hours rest in fresh air these cases are sufficiently restored to normal to return to duty, so that the British Army authorities retained such casualties in the zone of the advanced. It will be noted that the immediate symptoms of the sensory irritants do not give adequate warning of the more severe after effects. Although the breathing of extremely minute quantities causes violent irritation of the nose and throat followed by violent coughing and sneezing, the concentration in the air may be so low that the symptoms may not be followed by the subsequent effects indicated above.

Comparing diphenylchlorarsine and diphenylaminechlorarsine, the effects of DA are more marked than those of DM. With the higher concentrations, the effects of DA were more immediate and just as severe but not so persistent as those of DM. With lower concentrations, the symptoms of DM were more severe and more persistent than those of DA. DM appears, therefore, to be more efficient, since, from its lighter immediate effects, men would remain longer in the gas before seeking relief and would thus be disabled for many hours following the exposure.

Reports from British sources during the World War indicated the occurrence of certain remarkable sensory disturbances several days subsequent to the usual symptoms. Anesthesia, varying from mere numbness of the finger tips to a complete loss of sensation over a considerable part of one or more limbs was occasionaly observed. Commonly, this anesthesia was bilateral and of the type of glove or stocking distribution. These sensory changes were believed to be functional in character and not ascribed to toxemia from arsenic. Recovery was rapid and uniform.

A considerable number of instances of arsenical poisoning ascribed to the ingestion of water contaminated with diphenylchlorarsine were reported on the western front during the World War. The source of the water was usually from shell holes containing blue cross or DA chemical shell. The syndrome of generalized arsenical poisoning may occur under such conditions. This emphasizes the necessity of careful protection of drinking water supplies aboard ship under war conditions.

*The treatment of sensory irritant poisoning.*—A specific method of treatment has been developed at Edgewood Arsenal. This consists of the inhalation of chlorine gas of a concentration below the irritation point. The relief of symptoms is immediate. Chlorine gas reacts with the sensory irritants, forming a nontoxic compound as a product. However, since chlorine gas is so highly toxic, the treatment must be carried out with well-regulated precautions. Other plans of therapy, such as lavage of the nose and throat with boric acid solution or the inhalation of an alcohol-chloroform-ether-ammonia mixture, may afford some relief but are only palliative.

### (7) GAS PROTECTION OF THE SHIP

Gas protection, from the naval point of view, will be considered from the following viewpoints: (1) Individual protection, which comprises the equipping of a person with protective apparatus for individual use only and training in its manipulation, and (2) collective protection, which refers to all apparatus for protecting groups of men and equipment and to all general precautionary measures. A knowledge of all such matériel, training in its use, and general procedure are the three main factors in the problem of defense against gas.

(1) *Individual protection.*—The comparative newness of gas as a weapon and the mysticism that always attends chemistry in the mind of the layman have induced an unwholesome dread of gas among military personnal. It seems somewhat mysterious and supernatural. Instruction to personnel must therefore be given with a view to eliminating this peculiar fear of chemicals. The enlisted man should be taught to have only the same wholesome respect for chemical agents that he has for high explosives.

(*a*) The Navy gas mask: It is of interest to state that the present Navy gas mask is a product of evolutionary development and has passed through approximately 33 distinct changes, beginning with the early crude devices used on the western front in the first gas attacks.

The present Navy gas mask, while highly efficient, is by no means a finished product. It is constantly being improved in the same way that armor is constantly being improved. As new chemical agents are developed and as new methods of releasing them on the enemy are devised, the canister will have to be modified to meet the new menace, and work along this line is being carried out in many countries. However, the chemical and physical basis for modern canister design are sound, and slight additions and alterations of the present canister would suffice to meet any emergency.

The Navy gas mask consists of a rubber face piece which is connected by a corrugated rubber hose tube to a metal container known

as the canister. The face piece is provided with a diaphragm for speaking purposes. The protection afforded by the gas mask is provided by the canister, which is fitted with a filter whose function is to filter out irritating or toxic smokes, such as DA and DM, and is filled with chemicals which adsorb or neutralize toxic gases or vapors.

The chemical filling of the canister consists of activated charcoal and soda lime. The activated charcoal readily adsorbs organic vapors, such as mustard gas, lewisite, chlorpicrin, cyanogen chloride, etc., and, to some extent, acid gases, such as phosgene, chlorine, hydrocyanic acid, etc. These acid gases are eliminated more efficiently, however, by the soda lime, with which they combine chemically.

The nature of the adsorptive power of charcoal for gases and vapors is not definitely known. It is known, however, that it does not involve an absorption similar to the manner in which water is absorbed by a sponge, nor does it appear to comprise chemical action. It would seem that adsorption involves a force of attraction for gases and vapors which is analogous to the attraction of a magnet for iron filings.

The procedure for producing highly adsorptive charcoals, known as activation, was evolved during the World War, and coconut shells were found to be the best raw material. There is, of course, a limit to the adsorptive capacity of activated charcoal, and, further, the adsorptive capacity decreases as the amount of gas adsorbed increases. Also some gases are adsorbed more readily than others; as a general rule the more readily a liquid or liquefied gas vaporizes, the less readily is it adsorbed. There is, therefore, very little adsorption of air or of such gases as hydrogen or carbon monoxide by activated charcoal.

While the Navy gas mask gives practically complete protection against all chemical warfare agents which attack the lungs, eyes, and face, its definite limitations should be remembered. It does not protect against carbon monoxide or ammonia; it can not be used in atmospheres deficient in oxygen; and it is not designed to protect against concentrations of any gas higher than 1 per cent by volume. Such high percentages in air would never be encountered in chemical warfare operations in the field, but even higher concentrations may be met with in industrial practice. The Navy gas mask should, therefore, not be employed in connection with industrial gases unless information is available relative to the concentration of any gas against which protection is required.

The question is often asked: How long would be the life of a gas mask canister aboard ship? It is difficult to make an accurate estimate because it is impossible to forecast to what concentrations of gases it will be exposed in a future war, and for what lengths of

time. Based on past experience it is safe to say that a canister has a life of several months under the most adverse conditions likely to be encountered in the field and proportionately longer under favorable conditions. In any event, there is no hazard in using the canister to the limit of its capacity. When a canister begins to fail, gases penetrate it in such minute quantity that the odor or slight irritation would give adequate warning long before such gases could possibly penetrate in sufficient concentration to be a menace.

(*b*) The gas chamber: After men have been drilled in the use, inspection, and care of the gas mask, the final steps in the training are the fit of the gas mask to the face of the wearer, demonstration of the efficacy of the mask, and practice in gas-mask drill—all in an actual atmosphere of gas. This system has been adopted by the Navy, and gas chambers for this purpose are or will be available at the larger navy yards for the training of the crews of ships.

The gas chamber is simply a reasonably air-tight room or other inclosed space which contains a chemical agent such as chloracetophenone which is readily detected at concentrations which cause only momentary discomfort. If the face piece does not fit correctly, is adjusted improperly, or leaks, warning is given in the gas chamber without any more serious effect than a harmless irritation. More than any other phase of training, a trip through the gas chamber tends to dispel that superstitious fear of gas which exists in the mind of almost every inexperienced man. It brings home to the individual, as nothing else can do, the fact that his gas mask does protect him against irritating and toxic gases.

An important phase of training in individual protection is the development of the ability of individuals to recognize the presence of chemical-warfare agents in the field by their odor. This should be included in the plan of gas-chamber training. Small bottles containing samples of each standard chemical agent should be issued for identification drills. The procedure is for a man to take a moderately full breath of fresh air immediately before opening the sample bottle; then to remove the stopper and then to sniff gently of its contents; the bottle to be sealed as soon as the odor is detected.

The query is naturally raised: Are simple methods available for the ready detection of the chemical-warfare gases aboard ship? No satisfactory chemical or mechanical means has yet been developed by which chemical agents may be identified in the field. Such methods as are available require expert supervision and are too complicated to be used by military personnel.

(*c*) Protective clothing: The advent of mustard with its vesicant action in the World War introduced a new and urgent problem in gas defense. Heretofore protection had been required only for the

eyes and respiratory tract, which was accomplished by the gas mask. The situation now demanded protection for the entire body. The Chemical Warfare Service was therefore confronted with problems of the development of protective clothing, protective headgear, and protective footgear.

Two types of protective clothing have been produced, (1) the impervious type and (2) the impregnated type.

(1) The impervious type: This consists of a suit of the cover-all type, with elastic bands at the wrist and ankles to prevent vapors from entering at these points. The material has its outer surface treated with boiled linseed oil and resembles oilskin. Gloves of similar material protect the hands and wrists. A hood is attached to furnish protection to the neck and head. This type of clothing mechanically excludes mustard and all other vesicant vapors from the body and, in consequence, must exclude air. It is, of course, stiff, hot, sticky, and extremely uncomfortable to wear, as it interferes with the loss of heat and moisture from the skin. It can not be worn for more than an hour or two without excessive fatigue. Protective suits of this character are used by antigas or cleaning-up squads and employees in manufacturing or shell-filling plants.

(2) Impregnated clothing: This type of clothing is suitable for general use in that it chemically prevents the passage of vesicant gases and the porosity of the material to heat and moisture is not materially interfered with. It consists of the ordinary cotton or woolen uniform or underclothing which has been impregnated with a chemical compound known as impregnite, which destroys the vesicant gases which make contact with it. The impregnite does not appreciably change the appearance of the cloth and only increases the weight by approximately 15 per cent. It is not irritating to the skin and there is no discomfort if it is worn regularly. It will resist the leaching effect of rain and even three or four launderings without serious deterioration. Lastly, it is effective for the life of the clothing.

The aggregate amount of protection that impregnated clothing will render is practically constant. For instance, if the breaking-down point of a particular sample of impregnated cloth was arrived at after two hours' exposure to saturated mustard vapor, the same sample would be effective for 40 hours against a concentration one-twentieth that of saturated mustard vapor. In general, impregnated clothing furnishes 2 to 7 hours' continuous protection against saturated HS vapor, according to the weight of the cloth. The Navy Department has adopted a cotton impregnated cover-all of light weight for use aboard ships. This suit is of distinctive color, with an impregnated hood for head protection and with feet complete in

one piece. The leather shoes are also mustard-proofed by treatment with a certain modified type of oil daub and are no more uncomfortable to wear than waterproofed shoes.

The fact that impregnated clothing prevents the penetration of mustard vapor does not signify that it will resist splashing with liquid mustard. It will protect against minute droplets for a short time; that is, droplets of the size characteristic of a fog or mist. Against droplets having the size of raindrops protection will fail.

(2) *Collective protection.*—(*a*) The prevention of access of gas to battle stations of the ship: With the provision of gas masks and protective clothing individual protection is secured, but there is a marked decrease in the efficiency of the personnel, probably as high as 50 per cent, within a short time. For this main reason, among others, it is imperative that as many stations as possible be given collective protection in order that the personnel may function without wearing the gas mask. Naturally gas would not have access to sealed spaces of the ship, such as the control room, plotting room, torpedo and dynamo rooms, provided that all air ducts, voice tubes, etc., were rendered gas-tight. It would be necessary to regenerate the air in these compartments by supplying oxygen and air purifiers for the removal of $CO_2$ as in submarines.

For such semi-inclosed spaces as the conning towers, turrets, and sick bays, multitubular filters will be provided on ventilation ducts or blower intakes. These air filters embody the same principles as those in use in the gas-mask canister. The multitubular filter is made up of perforated cylindrical tubes, inclosed in similar, larger tubes, with a layer of activated charcoal and soda-lime granules in the intermediate space. The outer tube is wrapped with several layers of smoke filtering material which will hold back toxic smokes. These multitubular filters will be installed in the ventilation system of the compartment requiring purified air, A slight positive air pressure will be continuously maintained when the filter is in use.

With reference to engine and fire rooms the problem is more complicated. It would not be feasible to purify the general air supply. It is anticipated that such spaces will be provided with gas-proof control booths or stations with canistered ventilation, inside of which the operating personnel will not be required to remain masked.

The semiclosed compartments, including the broadside batteries and signal stations, are, in all probability, not adapted to any adequate form of collective protection. In these stations the protection of the personnel will be largely limited to the use of the gas mask and protective clothing. Of course no collective protection will be practicable for men on the open stations, such as the fighting tops,

antiaircraft-gun platforms, etc. Dependence must be placed only on individual protective measures. It must be remembered that the basic plan of gas protection of the ship calls for the equipping of the entire personnel with gas masks and protective clothing in addition to any measures of collective protection installed.

(*b*) The protection of matériel, food, and water supply: Certain of the chemical warfare agents have a corrosive action on metal. The vesicants are very difficult to remove from metal surfaces and are therefore a potential danger. Food and water contaminated with mustard or arsenical compounds should be disposed of as dangerous for use. Matériel and food must be protected by storing in air-tight storerooms, with the added precaution of inclosing in air-tight containers, oilcloth, tarpaulin covers, etc. All air connections of water tanks with the exterior should be protected by multitubular filters.

(*c*) Degassing of the ship: (1) The open spaces—The nonpersistent agents and toxic smokes will be carried away quickly by the wind or will disseminate into the surrounding atmosphere. No neutralization of these agents will be attempted in the open, but every effort must be made to prevent their entrance into the interior of the ship. The persistent agents, on the other hand, such as mustard and lewisite, must be quickly and completely cleaned up whenever found, and this promises to be a most hazardous task. These vesicants, when scattered on the decks and upper works of a ship, slowly give off toxic fumes. Moreover, their vesicant action makes walking about the decks or handling exposed gear a menace for many days or weeks, until they have been completely neutralized.

The cleaning up of mustard will present a prodigious problem. It can not be washed off the deck on account of its insolubility in water. It is readily absorbed by wooden decks and sticks tenaciously to metal surfaces. With its high surface tension it creeps into the seams of steel decks and bulkheads.

The various methods for the destruction of mustard rest on two broad principles; i. e., chlorination or hydrolysis. With free chlorine higher chlorinated substitution products are formed which are either nonvesicant or of greatly reduced vesicancy. Hydrolysis, which is ideally effective with live steam, results in the formation of absolutely harmless products. Suffice it to say that the full solution of the problem of the cleaning up of mustard on naval vessels demands further research.

Chloride of lime will destroy mustard on account of its available chlorine. It might be necessary to spray the entire upper works of a battleship with a saturated solution; every square inch, every nook and corner, every element of the mast, every line and wire, each

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winch, all the anchor gear, boats, antiaircraft guns, searchlights; in fact, every place where the smallest drop of mustard may have lodged. This would be succeeded by a complete washing down with hot salt water.

(2) The semiopen spaces: It is probable that nonpersistent agents getting into these spaces through penetrating shells or leaks can be disposed of by means of the ventilation system if this remains intact. To remove persistent compounds the methods employed for the open spaces would be generally applicable.

(3) The closed spaces: Persistent gases may find access to compartments in shell; through torpedoes or mines; by infiltration through sprung bulkheads or a damaged ventilation system. The first step is to confine the gas to as small a space as possible. Ordinarily the ventilating system can be relied on to clear closed compartments of nonpersistent gases, bearing in mind the danger to other compartments from exhausts that do not necessarily lead into the open air.

The chemical principles of various methods for the destruction of mustard have already been indicated. The practical details are beyond the scope of this paper. The neutralization of lewisite can be secured by contact with sea water—a simple problem as compared with mustard.

(*d*) The degassing of clothing: Clothing worn during an exposure to mustard vapor, unless it be of the impregnated type, will retain sufficient of the vapor to become contaminated; varying in degree in direct ratio to the time-concentration factor. Severe burns may ensue from clothing worn which has been exposed to a concentration of 0.1 ounce per 1,000 cubic feet for 1 hour. Such clothing could be readily demustardized by exposure to ordinary live steam for 1 hour. If the clothing were infected with liquid mustard, 4 hours of steaming would be essential. The laundry facilities of a battleship should be feasible for this procedure. Other less expeditious methods are also available.

(*e*) Organization for bathing procedure: The entire personnel of a ship should be put through a prophylactic bathing procedure with hot water and soap if there has been the slightest doubt as to contamination after a mustard attack. It should be arranged so that a maximum number of men will be bathed in a minimum period of time. In the organization of such a procedure three sections should be planned as follows: (*a*) A reception department for the collection of all men to be bathed; (*b*) bathing and irrigation department; this would include the spraying of the eyes, nose, and throat with a simple lotion; (*c*) clothing and evacuation department; fresh clothing would be issued under (*c*) and all uniforms and underwear sus-

pected of contamination would be demustardized. A systematic inspection of all such personnel by the medical officer for any evidence of mustard lesions would be comprised under this routine.

### (8) NAVAL MEDICAL TACTICS IN GAS WARFARE

The introduction of gas warfare presents to the naval medical service new problems both from the standpoint of the organization of the Medical Department in battle and the clinical side. In view of the facts that the subject is comparatively new and that naval forces have not yet engaged in chemical warfare, detailed plans to meet the situation from the medical department viewpoint have not been formulated. The writer will merely attempt to point out certain important aspects of the topic.

It must be contemplated that a gas attack may accompany a general fleet engagement, or it may occur alone. The preparations and organization will, of course, differ with the two sets of conditions. We are confronted with the question as to what can actually be accomplished while an attack is in progress. In any event, the handling of the situation would be much less complicated if the gas attack were not simultaneous with a high-explosive shell bombardment.

*Treatment and disposition of gas cases.*—From the viewpoint of the handling of gas casualties on a large scale the following broad classification is indicated: (1) Slight—from the lachrymators; (2) early acute but temporary—from the sensory irritants; (3) early acute—from the lung irritants; (4) late acute—from the vesicants. The lachrymatory cases of course are not stretcher cases and could ordinarily be returned to their stations within a short time as the symptoms so quickly subside. On the other hand, the sensory irritant casualties may suffer severe symptoms. While a certain number will require transportation, it is probable that the greater number could walk to the battle dressing or medical gas station.

With the lung irritant cases, if real gas poisoning does exist, great caution must be taken in transportation. From the beginning, these casualties must be handled as stretcher cases in order to minimize the danger of pulmonary edema, particularly in view of the delayed onset of edema with phosgene.

Mustard cases form a complete contrast, as symptoms, both cutaneous and pulmonary, are delayed in onset and there is no risk in walking in the early period. Later on, however, when the question of evacuation to a hospital or base hospital arises, much caution may be required in deciding on moving mustard gas cases as late broncho-pneumonia may have developed.

The early treatment: For the lung irritants this may be summarized as rest, oxygen, and venesection; for the vesicants, bathing,

the careful neutralization, if possible, and removal of any visible agent and the prevention of infection of burns; for the sensory irritants, lavage and inhalations of low concentrations of chlorine.

Gas medical stations: These are provided in the Army medical organization in the field. While this would be the most efficient method of handling gassed cases aboard ship, the limitations of space would probably render it impracticable, at least in connection with a general naval engagement. It appears likely that the usual battle dressing stations would be modified to care for the gassed along with the other wounded. The installation of air locks for the dressing station and the removal of the clothing of cases before reception would be essential to prevent the access of gas to this space.

Under conditions of a gas attack not associated with gunfire, it would appear feasible to have available a medical gas station above the protective deck. Such a space as the crew's wash room would be conveniently located and the necessary special supplies and equipment could be permanently installed for such an emergency.

Equipment of first-aid stations: To the usual equipment of first-aid boxes for the battle stations should be added the following items: Carbon tetrachloride, with gauze sponges for the removal of mustard from the skin; 5 per cent sodium hydroxide for the neutralization of liquid lewisite; a 2.5 per cent solution of sodium carbonate for use with lachrymators and toxic smokes, and a 2 per cent solution of copper sulphate for phosphorus burns. At the battle dressing-stations a special equipment should be provided for the emergency treatment of all types of gas cases. Special gas stations, if it be practicable for them to be set up, should have an adequate oxygen equipment for the simultaneous administration of oxygen to considerable numbers of casualties.

The training of the Hospital Corps in the general measures of gas defense—particularly the transportation and first-aid measures of gas casualties—must also be considered. Drill in the use of a special gas mask for head injuries would be included.

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# PHYSIOLOGY OF RESPIRATION IN RELATIONSHIP TO THE PROBLEMS OF NAVAL MEDICINE *

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## PART I (Continued)

### THE LUNG VOLUME AND ITS SUBDIVISION

Hutchinson, in 1846, made a careful and extensive study of the capacity of the lungs by means of a spirometer. He introduced the various terms that are used at the present time, though some of them have been modified in a manner that causes a great deal of confusion. Meakins and Davis (7), in their excellent book on the respiratory

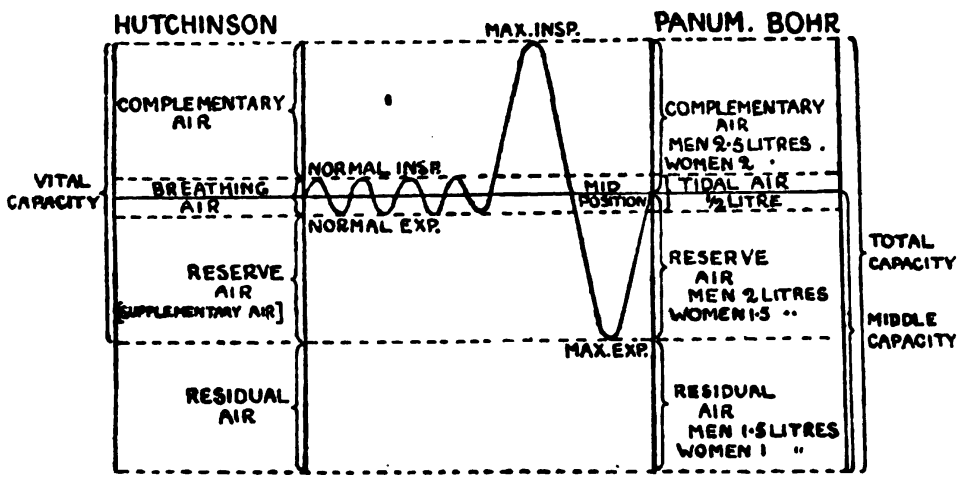


FIG. 3.—The total lung volume and its subdivisions as defined by Hutchinson and by Panum and Bohr. (From Meakins and Davies, Fig. 46, p. 387)

function in disease, have made these differences clear in the diagram which is reproduced in Figure 3.

We shall quote their explanation verbatim:

"There are five portions of air which go to make up the total lung volume. These are:

"(1) The residual air, which was first accurately measured by Humphrey Davy, and can not be expelled even by the greatest possible expiratory effort.

"(2) The reserve air is that proportion of air which can still be expelled from the lungs at the end of a normal expiration.

"(3) The tidal air, or, as Hutchinson termed it, the breathing air, is that volume of air which is inspired and expired during normal respiration.

* The first portion of this paper was published in the January, 1928, number of the UNITED STATES NAVAL MEDICAL BULLETIN.

"(4) The complementary air is the largest amount of air which can still be inspired at the end of a normal inspiration.

"(5) The vital capacity is the sum of the reserve, tidal, and complementary air—that is to say, the maximum amount of air which can be inspired at the end of a forced expiration, or, conversely, the maximum amount which can be expired at the end of the largest possible inspiration.

"These are essentially the definitions given by Hutchinson, and they are still used by the majority of writers of textbooks of physiology. Many recent research workers have used the terms 'reserve' and 'complementary air' in a slightly different sense, however, and some confusion of terminology has resulted. Hence, in referring to any original papers on the subject of lung volume, the reader is advised to note carefully how these various terms are defined. The majority of recent workers have used the terms in the sense used by Panum and Bohr. If one stops breathing at a point midway between normal inspiration and normal expiration (the mid-position), the amount of air present in the respiratory tract is termed the middle capacity. The maximum amount of air which can still be inspired from this point is sometimes called the complementary air, while all that which can be expired is termed the reserve air. The differences between these definitions and those of Hutchinson are made clear by the accompanying diagram. Thus it can be seen that the 'complementary air' and 'reserve air' of Panum and Bohr are each greater than those of Hutchinson by an amount equal to half the tidal air. The average amount of tidal air varies greatly in different individuals and in a given individual at different times and under different conditions of rest, work, and so on. It seems probable that the mid-position, although an arbitrary point, is somewhat less variable. Therefore we feel justified in following the lead of a number of recent workers and recommending the adoption among British writers of the definitions of Panum and Bohr.

"An additional subdivision of total lung volume has recently been introduced by Binger and Brow, namely, the functional residual air. By this they mean the total amount of air present in the respiratory tract at the end of normal expiration."

Binger (8) has recently measured the various subdivisions of the lung capacity of seven normal men and seven normal women. He found that the averages were as follows:

*Percentage of the total lung capacity*

| | Vital capacity | Residual air | Middle capacity | Reserve air | Complementary air |
|---|---|---|---|---|---|
| Men | 74 | 26 | 60 | 34 | 39 |
| Women | 69 | 31 | 64 | 33 | 36 |

This means that a normal man can use about three-fourths of his total lung capacity in very deep breathing. The average woman can not use quite such a high proportion. We may, therefore, estimate the total lung capacity by the simple method of measuring the vital capacity, and this test has been found extremely useful. There are several good spirometers on the market. All that is necessary is to have the subject breathe as deeply as possible and then exhale into the spirometer as fully as possible. Three or four trials are necessary and the maximum figure should be taken. Much work has been done to establish the normal limits and this is fully discussed by Peabody (9), Means (10), and Meakins and Davies (7). Hutchinson found the vital capacity proportional to the height. Dreyer (11) believes that it is more nearly proportional to the stem length, which is approximately the same as the sitting height. West (12) observed that it was closely correlated with the surface area as determined from the height-weight chart of Du Bois and Du Bois (13). He found that the vital capacity expressed in liters was two and five-tenths times the surface area expressed in square meters in men and twice the body surface in women. Many other formulas have been suggested, but Means and Meakins and Davies, clinicians of large experience, believe that the formulas of West are the simplest and most convenient. Everyone agrees that the normal range is a wide one and that we must be careful in our interpretations.

The vital capacity is greatly diminished in certain diseases, notably pneumonia, pleurisy with effusion, extensive tuberculosis, emphysema, heart disease, hyperthyroidism. In general, the reduction in vital capacity goes hand in hand with the progress in the disease and it can be used as a prognostic index. If the vital capacity is greatly lowered there is usually dyspnea, even at rest; if the reduction is moderate, the dyspnea will appear only on exercise.

Peabody (14) found that the tidal air during exercise is usually about one-third of the vital capacity and that the rate of breathing, even in strenuous exercise, is seldom above 35 per minute. It is, therefore, obvious that since the rate can not be effectively increased above 35, the amount of air that can be breathed during exercise will be proportional to the vital capacity.

The question of the value of testing the vital capacity of recruits and men who apply for special duties is of considerable importance to medical officers. It is well established that athletes have high vital capacities and that men in poor condition give low figures. Dreyer and Hanson (15) have used the vital capacity as a test of physical fitness and their work is stimulating and important, though it has been the target for many criticisms, directed chiefly against

the fact that they based their figures on only 16 individuals. The consensus of opinion seems to be that the test is simple and of considerable value if due allowance be made for the normal variations. It should always be supplemented by other tests and should not be taken to mean much more than that there is a large functionating lung capacity. It will not, for instance, tell us whether or not a man is particularly well fitted to withstand high altitudes.

If a man's lungs were near the surface, like the gills of a fish, his blood would be exposed to the enviromental air. As a matter of fact, they are deep in the body at the end of a series of long tubes which serve no purpose other than that of conducting and moistening the air. These air passages constitute the so-called dead space, which is made up of nasal cavities, trachea, bronchi and bronchioles down as far as the respiratory bronchioles, where functioning alveoli first make their appearance. These respiratory bronchioles branch into what W. S. Miller calls alveolar ducts, which act chiefly as air passages, though they are lined with alveoli. Each alveolar duct in turn breaks up into several atria which lead to the air sacs. It is in these air sacs and atria that the great bulk of the respiratory exchange takes place, and these contain the true alveolar air. The respiratory bronchioles, ductules, and atria occupy a position which is functionally as well as anatomically midway between dead space and alveoli. There is evidence to indicate that under varying conditions the relative importance of these two changes and that the functional dead space may increase as these dilate with deep inspiration.

The dead space, under ordinary conditions, is estimated at about 140 cubic centimeters. At the beginning of an inspiration, this amount of air is drawn down from trachea and bronchi into the lungs and goes back into the alveoli which it had just left two seconds previously. Following this comes the fresh air of the tidal inspiration. The stale air and fresh air mix in the alveoli and then follows the tidal expiration which leaves another 140 cubic centimeters of stale air in the dead space. Thus the first 140 cubic centimeters of each inspiration is more or less wasted. The more rapid and shallow the breathing, the larger is the proportion so wasted. Deep, slow breathing is more efficient from the standpoint of ventilating the alveoli.

A man increases his dead space if he sleeps with his head covered by his blanket, because he rebreathes some of his expired air.

Air diffuses rapidly, but there is resistance to its movement along the wall of a tube. Thus, the air contained in the dead space does not move downward in a solid mass but, according to the studies of Yandell Henderson, the fresh air channels through it as an advancing

spike. There are probably similar currents, eddies, and "slack waters" in all gas masks. Even the best of the gas masks increase the functional dead space because they all hold some expired air which is rebreathed on inspiration. The simplest illustration of this is an ether cone or the old German gas mask. With these the man breathes in and out of the same opening and the whole capacity of the mask acts as additional dead space. When flap valves or flutter valves are added they are placed as near to the mouth as possible, but even so there is some dead space between the valves and orifice of the body. Probably the functional dead space of the mask is smaller than the actual dead space because the valves are usually so directed that the air channels pass from valve to nose and vice versa. It is an important feature of all types of gas masks and oxygen apparatus that the dead space shall be as small as possible in order to diminish unnecessary breathing of expired air.

### The Alveolar Air

Man lives in the environment of his alveolar air. It is this that bathes the blood coming from the tissues. Perhaps we should go back one step farther and say that he really lives in the partial pressure of oxygen and carbon dioxide that are found in the tissues themselves. We can not estimate these tensions with accuracy and, therefore, must content ourselves with the alveolar air, which can be measured fairly satisfactory. The Haldane method of analysis consists in having the subject make a full expiration through a long tube and then collecting a sample from a side tube which withdraws the last portion of air exhaled. In normal men this has an almost constant composition, containing about 5.6 per cent $CO_2$ which is equivalent to about 40 millimeters murcury pressure. With changes in the atmospheric pressure the percentage of $CO_2$ changes in an inverse proportion to the total pressure, but the partial pressure of this gas remains about 40 unless there is actual oxygen want. As we shall see later, this alveolar $CO_2$ is the delicate regulator of the reaction of the blood, which in turn is the regulator of respiration. Even such a slight rise as 0.2 per cent, or 15 millimeters, in the partial pressure will cause an increase in respiration which will double the alveolar ventilation. In this manner the organism maintains a constant environment for the blood in the lungs and, therefore, in the body tissues. There are also other regulating mechanisms which will permit a change in the alveolar $CO_2$ by adding or subtracting acids or alkalies from the blood. Under ordinary conditions the respiration is so regulated that the alveolar air remains constant.

This air in the alveoli is refreshed not so much by the actual drift in and out of the lungs by tidal air as by the diffusion of this tidal

air from bronchioles and alveolar ducts into the atria and air sacs. The distance to be traveled is short and the gases diffuse rapidly. Once in the air sacs there is only the thickness of one thin cell between them and the blood in the lung capillaries. The oxygen diffuses into the blood plasma and the carbon dioxide out of the blood plasma according to the physical laws of diffusion. The rate is proportional to the partial pressure of the gas, the coefficient of solubility in the membrane and plasma, and universally proportional to the square root of the molecular weight. The oxygen in the plasma is rapidly seized by the hemoglobin, except for a small portion which remains in solution. The carbon dioxide is bound chiefly with the bases, forming bicarbonates such as $NaHCO_3$, and a small portion unites with water to form $H_2CO_3$. Some physiologists believe that part is combined with hemoglobin. Certain it is that the presence of a large portion of carbon dioxide helps the expiration of $O_2$ and, vice versa, a high percentage of oxygen helps the expiration of $CO_2$. This principle, discovered by Bohr, is sometimes called the Bohr effect or phenomenon.

Haldane (16), whose opinion must be treated with great respect, believes that under certain conditions the alveolar membrane actively secretes oxygen inward. In this view he is followed by his own school but not by most physiologists. He calls attention to the fact that fishes can secrete almost pure oxygen into their swim bladders. It is unfortunate that the sailorman has no such bladder as it would help him to float and would also act as a reservoir of oxygen. Man's present reserve of oxygen consists of the small percentage in his lung air and even smaller amounts in his blood and tissues. A man will exhaust this oxygen if he takes 8 or 10 breaths of pure nitrogen or hydrogen. Then he loses consciousness and a few seconds later the heart may be paralyzed.

### The Regulation of Breathing

Quiet respiration continues without our being conscious of its existence. The tidal air enters and leaves the lungs with a surprisingly uniform depth of inspiration, the thorax returning to almost exactly the same position at the end of each expiration. This is accomplished by the reflex discovered by Hering and Breuer. When the lungs reach a certain point of distention the stimuli transmitted along the vagi cut off the impulse and start expiration. When the lungs reach a certain point of exhaustion other stimuli along different fibers in the same nerve stop the expiration and start inspiration. The action reminds us of the windshield wiper of an automobile or the automatic device which causes a ventilating fan to rotate from side to side.

The points at which this Hering-Breuer reflex acts are regulated by the respiratory center, which in turn is governed by the reaction of the blood (hydrogen ion concentration). Thus when the points of the reflex are set farther apart the respiratory excursions become greater. A similar effect can be secured in an oscillating electric fan by changing the automatic adjustment. In addition, when respiration becomes conscious the will can assume control and force deep respirations or, conversely, stop them entirely.

The respiratory center or centers are situated in the medulla in close connection with the central termination of the vagus nerves. These centers control and coordinate the movements of respiration, and if they are destroyed or injured seriously the movements of respiration cease at once. The vagi themselves are not essential to respiration. Section of the phrenic nerves will paralyze the diaphragm but respiration may be carried on by the thoracic muscles. On the other hand, the diaphragm, if its nerves be intact, can maintain respiration without the other muscles. The respiratory center is the one part of the human organism that is of the utmost importance to life. When it fails life terminates abruptly unless artificial respiration continues it for a limited period. Almost all deaths due to failure of the respiratory center are caused by its receiving insufficient oxygen. This very center which controls respiration seems to be one of the parts of the body most easily damaged by lack of oxygen. It is exquisitely sensitive to an excess of $CO_2$ or any other acid. An increased acidity is the one true stimulant.

### Acid Base Regulation

The reaction of the blood is delicately adjusted a little on the alkaline side of neutrality. Speaking more exactly in terms of physical chemistry the $_pH$ is about 7.35. The faint degree of alkalinity is guarded jealously by the organism in order that its cells may live in an absolutely uniform environment. In certain extreme conditions the blood becomes a little more alkaline or less alkaline, but, in general, the body shows physiological responses to changes which are much more delicate as indicators than any other methods of analysis now available.

We have seen that the rate of ventilation is roughly proportional to the total metabolism. More exactly, it is proportional to the $CO_2$ elimination. If, however, acid or alkali be added to the blood stream the level of the $CO_2$ tension is changed and with it the volume of ventilation. The greater the tendency toward acidity the greater the ventilation. Means (10) has expressed the two laws of respiration of Haggard and Henderson in the following simplified terms: "(1) With a constant carbon dioxide tension, ventilation will vary

directly with the carbon dioxide output, and (2) with a constant carbon dioxide output, ventilation will vary inversely as the carbon dioxide tension."

In the blood the reaction (hydrogen ion concentration, $H^+$) is represented by the balance between the carbonic acid and bicarbonate: $H^+ = K \frac{H_2CO_3}{BHCO_3}$. The fraction $\frac{H_2CO_3}{BHCO_3}$ has a value of about $\frac{1}{20}$, and K is a constant equaling $7 \times 10^{-7}$. If we add acid to the blood we drive $CO_2$ from the bicarbonate and form more carbonic acid. This increases the $CO_2$ in the blood and increases the ventilation until not only is the extra $CO_2$ washed out but the ventilation is maintained at a rate that will keep the $CO_2$ lower than normal. If the denominator of the fraction ($BHCO_3$) is cut in half by the acid, the numerator ($H_2CO_3$) will be cut in half by increased ventilation, which lowers the percentage of $CO_2$ in the alveolar air and consequently keeps it low in the blood. The respiratory center is delicately adjusted at a certain fixed reaction (hydrogen ion concentration) of the blood and any tendency toward increased acidity either due to $CO_2$ or to fixed acids causes increased respiration. As a result, the volatile, easily removable acid, $CO_2$, is expelled until the reaction becomes normal once more.

It is possible to add a good deal of acid to the weakly alkaline blood before it will turn acid to litmus paper. The bicarbonates unite with the acid, releasing $CO_2$ which escapes from the blood. This is an example of a buffer substance which helps keep the reaction almost neutral. Among the other important buffers of the blood are the phosphates and the proteins which can act as weak acids or weak alkalies.

In addition to these buffers, the kidneys are able to excrete large amounts of acid radicles, chiefly acid phosphates, when properly stimulated by an increasing tendency toward acidity in the blood or by a condition of oxygen want. They form ammonia in sufficient quantity to unite with these acids and excrete them in this combination. The intestines also are able to help in eliminating some acids, and the liver also may help. An additional supply of bases can be mobilized from the bones and other tissues to help neutralize acids.

Conversely, if alkalies are added to the body the $CO_2$ excretion will be diminished and the kidneys will strive to excrete more bases.

The most striking form of acidosis occurs in severe diabetes when the fats are incompletely oxidized because the body is unable to oxidize carbohydrate at the same time. Aceto-acetic and B-hydroxybutyric acids are formed in large amounts. They diminish the bicarbonate reserve in the blood and cause an increased ventilation, the well-known slow deep breathing of diabetes called Kussmaul breathing, or air hunger. At the same time the kidneys are doing

their best to excrete these acids in combination with newly formed ammonia and the bases are being mobilized from the bones.

The acidosis of severe nephritis is caused by the inability of the damaged kidney to excrete the acids which are the normal products of some of the foods, especially the proteins. In treating such a nephritic acidosis some clinicians have given too much alkali. This excess could not be excreted any better than the acids, so the patients were forced into an alkalosis.

In the rare disease of tetany, caused by insufficiency of the parathyroids, there is always a tendency toward alkalosis. A type of compensatory alkalosis is also found in the process of adaptation of mountain climbers to high altitudes. Very deep breathing, either voluntary or as a result of surgical shock, can cause a marked alkalosis on account of the washing out of $CO_2$ (Acapnia) and the kidneys may compensate in such a manner that the $CO_2$ curve of the blood may suggest an acidosis instead of the true alkalosis. There is no one test of $CO_2$ content of blood or $_pH$ of blood that tells the whole story.

In addition to these extreme cases above mentioned, there is a constant delicate adjustment throughout the day. Thus a meat diet with its extra tendency toward acid end products causes a slight change in alveolar $CO_2$. After food enters the stomach there is an excretion of hydrochloric acid into this organ, and this loss of acid from the rest of the body must be balanced. A few hours later there is an outpouring of alkali into the intestines, and this in turn must be compensated. One of the most striking outpourings of acids comes when a man takes violent exercise. Large amounts of lactic acid are formed and these cause an acidosis much greater than that usually found in diabetes. It is compensated by the body in a short time, and later the lactic acid is partly oxidized, but chiefly reformed into glycogen.

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## PART II

### Respiration in Disease

The most striking clinical manifestations of disturbance of the respiration are dyspnea, orthopnea, and cyanosis. Meakins has defined dsypnea as "the consciousness of the necessity for increased respiratory effort." Means (1) has described its causation in the following words: "Dyspnea will occur whenever the repiratory mechanism can not with ease functionate to the extent that bodily processes require."

The patient usually refers to his respiratory embarrassment as a shortness of breath or poor wind. This is first noticed when he exercises and finds himself out of breath much sooner than he had expected from his previous experience. As the condition progresses, the dypsnea is elicited with smaller and smaller amounts of exertion. One of the simplest measures of respiratory efficiency is stair climbing. Careful history taking may elicit such facts as these: "The patient lived three flights up in a tenement. Before July, 1926, he had been able to climb these stairs without stopping. In July he noticed shortness of breath and was obliged to pause at the top of each flight in order to catch his breath. By August he was climbing very slowly and sitting down on the stairs to rest. Now, in September, he can not leave his tenement and is short of breath whenever he leaves the bed. Even in bed, he is not comfortable unless propped up with many pillows. His friends tell him that his lips and finger tips are blue."

There are several clinical varieties of disturbances of breathing. Tachypnea is rapid breathing; hyperpnea, deep breathing, or extreme ventilation. This is best seen in the "air hunger" (Kussmaul breathing) of diabetic acidosis. Here the respirations are slow and deep, the type that gives the greatest ventilation of the alveoli per minute. A rapid, shallow type of breathing is notoriously inefficient in oxygenating the blood.

Some few patients can lie flat on their backs when suffering from considerable degrees of dyspnea, but most of them ask for back rests

and pillows. This is called orthopnea, the type of dyspnea in which the patient must sit up in bed or even in a chair. At first this seems unnatural because most of us sleep flat in bed, and we know that metabolism is increased about 10 per cent by sitting upright in a chair. As a matter of fact, the semireclining position of the steamer chair or back rest involves no increase in metabolism over the flat position. It makes breathing much easier from a mechanical standpoint and helps the accessory muscles of respiration. There is an upward pressure on the diaphragm when the subject is flat on his back. This is due to the weight of the abdominal organs, especially the liver. If there happens to be a collection of fluid in the abdomen (ascites), or a marked distension of the stomach and intestines, this pressure is greatly increased. Under such conditions the diaphragm and heart may be shoved so high that the apex beat is felt in the third intercostal space instead of the fifth. As soon as the patient is propped up in bed gravity shifts the pressure into the pelvis, where it does little harm, and the weight of the liver pulls the diaphragm downward. The vital capacity is increased and consequently the reserve power of the lungs also. With the improvement in the action of the heart and the increase in respiration, the flow of blood into the thorax is facilitated. Anything that helps the circulation will also help the lungs.

One striking evidence of impaired respiration is Cheyne-Stokes breathing. A peculiar rhythm appears and periods of apnea are followed by waves of deep breathing. This is best appreciated if you yourself try to copy the rate and depth of respiration. After the period of apnea you find yourself imitating first a small inspiration followed by larger and larger excursions until finally they become very deep. About the time you are dizzy from overventilation the patient's respirations wane and finally cease. Then comes a period of absolute cessation which may last half a minute or even a minute and you feel as if you could hold your breath no longer. Then the breathing is resumed and the blood oxygenated once more. The patient is usually anxious and restless during the period of deep breathing. He is quiet during the apnea and perhaps these short intervals are the only moments during which he is able to sleep.

The picture given above is found only in the extreme cases of cardiac or renal disease. Milder grades are frequently encountered in which the rhythm can be discerned only on careful observation. The phenomenon is important because it is always a sign of incomplete oxidation of the blood and tissues, anoxemia.

We are not quite certain as to the exact causation of Cheyne-Stokes breathing, but the explanation of Douglas and Haldane seems the most probable. They believe that the respiratory center is

rendered more excitable by oxygen want, and this makes it more sensitive to an accumulation of carbon dioxide. Normally the center acts smoothly and responds quietly and efficiently to moderate fluctuations in the $CO_2$ by damping any sudden changes in somewhat the same manner as the flywheel of an engine. When, however, the center is rendered more sensitive this flywheel action is lost, and the center, which is always bathed with a certain amount of $CO_2$, responds vigorously when the oxygen pressure in the blood falls below a certain level. As the respirations increase in depth the blood in the lungs is better oxygenated, but it takes several seconds for this blood to reach the center. A few seconds later the oxygen want is gradually relieved, the sensitivity to $CO_2$ diminished, and the stimulus finally abolished. Now in the period of apnea, the center begins to receive blood poorer and poorer in oxygen and finally the threshold of response is once more attained. Thus we have rythmic instead of regular breathing.

Cyanosis, a blue tinge to the skin and mucous membranes, always means an excess of reduced hemoglobin. It may be so marked that the patient is a deep blue color, "almost black in the face." Any layman can recognize such an extreme case, but it takes an experienced observer to detect the slighter degrees. The medical student may get the impression that the color is unusually good, but if he observes carefully he notes a faint bluish tinge of the lips, finger tips, nose, and malar regions. Faint cyanosis of the finger tips is best demonstrated by placing your own fingers in between those of the patient and comparing the colors in a good light.

Lundsgaard (2) has shown that the chief factor in producing cyanosis is the absolute concentration of reduced hemoglobin in the blood. The rare conditions of methemoglobinemia or sulphemoglobinemia may occasionally contribute to the blueness, but in ordinary diseases they are of little importance.

Normal blood contains in round numbers about 20 volumes per cent of oxygen, arterial blood about 19 volumes per cent, venous blood about 14 volumes per cent. Therefore, arterial blood (A) contains 1 volume per cent reduced hemoglobin and venous blood (V) 6 volumes per cent. We can assume for purposes of calculation that the capillary blood (C) is about halfway between the two,

$$\frac{A+V}{2} = C, \text{ or, under normal conditions, } \frac{(A)1+(V)6}{2} = (C)3.5$$

When the figure for the capillary blood reaches 6–7, about twice the normal, cyanosis makes its first appearance. Such a condition is reached if about one-third of the blood passing through the lungs is unaerated.

The actual percentage of the hemoglobin in the reduced form is of less importance than the absolute amount. Thus patients with anemia whose blood contains 25 per cent or less of the normal amount of hemoglobin seldom show cyanosis because there is never a sufficient amount of reduced hemoglobin. On the other hand, a person suffering from the rare disease of polycythemia with much more hemoglobin than normal shows cyanosis on slight provocation.

There are other factors than reduced hemoglobin but all are of minor importance. The thickness of the epidermis is one of these, as we can best realize from the fact that the blue color is first apparent under the thin skin of the malar eminences and tip of the nose. The natural pigment of the skin and color of the blood plasma are of some importance. The color that we see is due chiefly to the blood in the capillaries; therefore, it depends to a certain extent on their number, their length and width. It is obvious also that if the blood assumes its venous character early in its passage through the capillaries, the blue color will be intensified. Unfortunately, we have no means of making exact analyses of the capillary blood in its short passage through the tissues.

The diseases in which cyanosis appears will be discussed more fully in the following pages. Lundsgaard and Van Slyke (2), in their admirable monograph on cyanosis, have expressed in mathematical form the relative effects of the different fundamental causes. They call attention to the amount of hemoglobin deoxygenated in its passage from the arteries to the capillaries. This is proportional to the total metabolism of the individual tissues and varies with the level of the basal metabolism and the functional activity of the part and of the whole body. They discuss the fraction of blood shunted through totally unaerated channels in the lungs or through abnormal communications between right and left hearts. The most important cause seems to be that fraction of total hemoglobin passing in reduced form through aerated portions of the lungs. These portions of the lungs may be called aerated and yet contain air so small in amount, or so poor in composition, that they do not serve their usual function. On the other hand, the blood may be of such nature that it can not absorb the normal amount of oxygen or the walls of the alveoli may be sufficiently altered to prevent the gaseous exchanges from taking place with their normal rapidity.

### *Mechanical obstructions to respiration*

To the average practitioner the term "respiration in disease" suggests little more than a mere enumeration of the number of respirations per minute. As a matter of fact, the rate of respiration

is of little importance, but the total amount of air breathed during a given period is of great importance. We should train ourselves to think in terms of effective ventilation and consider the number of liters of air which reach the alveoli per minute.

Disturbances to respiration may originate in the upper air passages. If a nursing baby suffers from an obstruction in the nasopharynx due to adenoids he can not breath through his nose while at the nipple. As a result, he first tries to nurse and then tries to breathe and neither process is entirely satisfactory. At the other extreme is the infant with hare lip and cleft palate. In his case, the air passages are so wide that he can not exert any suction and he may starve if not fed artificially.

Older children with adenoids find such difficulty in breathing through the nose that they become mouth breathers and this produces the well-known effects on the shape and expression of the face. It seems also to predispose the children to infections of the upper respiratory tract and ears. All physicians know the dangers of mouth breathing and yet many pay no attention to this when it occurs in their fever patients. For example, in typhoid fever it is important to give the patient large amounts of food and drink. The patient will not take these because he has no appetite. The chief reason he has no appetite is that his mouth is dry and his lips and tongue cracked. The lips and tongue are cracked because he is breathing through his mouth, and he is breathing through his mouth because his nose is stopped with dried mucus. A skillful nurse can keep the nasal passage free and restore the mouth to its normal condition.

The effects of an obstruction to respiration are easily demonstrated when a man wears a gas mask. One of the great problems of war is the resistance to breathing found in all such appliances. A considerable amount of effort is required to draw the air through valves, tubes, and chemicals and expel it through the flutter valve. It is possible to construct a mask with low resistance, but this will not give protection against high concentrations of lethal gases or last more than a few minutes against low concentrations. A good mask necessarily has a fairly high resistance. This is scarcely noticed by the wearer when he is at rest, but when his respiratory volume per minute is increased by running or serving guns the distress may become acute. Many a poor soldier has mistaken these symptoms of dyspnea for those of gas poisoning and has torn off his mask thinking it defective in protection against the gas.

Obstructions may occur anywhere along the respiratory passages, but the point of greatest danger is the narrowest portion, the rima glottis. Here, between the vocal cords, nature has left but a small factor of safety, and it only takes a tiny foreign body or insignificant-looking diphtheritic membrane to cause symptoms. If the

obstruction be very small the respiration becomes deeper and slower and there is little interference with the aeration of blood. When the obstruction is increased the dyspnea becomes greater, and the respiration becomes shallow and rapid and cyanosis appears. The respiratory center is greatly stimulated by the accumulating $CO_2$, but it is also weakened by the scant supply of $O_2$. This anoxemia of the respiratory center in itself tends to produce rapid shallow breathing which happens to be the worst type for such an emergency. Finally the vicious circle causes exhaustion of the center and death.

If a foreign body or new growth obstructs only one bronchus the air is shut off from one or more lobes, but the blood may continue to flow through this unaerated portion. This blood receives no fresh oxygen and, therefore, when it mingles with the blood from the normal lobes it reduces the oxygen content of the mixture and cyanosis results. The oxygen deficiency may or may not be serious, but in either case it can not be relieved by excessive ventilation of the good lobes. The blood that passes through these good lobes can take up very little more oxygen than usual because it is about fully saturated even with quiet respiration. Matters are different, however, with the $CO_2$ on account of the difference in the shape of its absorption curve. The excess of $CO_2$ resulting from the admixture of unaerated blood is removed by a little hyperventilation of the good lobes.

The type of obstruction most often observed in the clinic is that due to the accumulation of fluid in one or both pleural cavities. In the case of a unilateral pleurisy with effusion the fluid may collect fairly rapidly and fill the greater part of the cavity. The lung shrinks on account of its elasticity, no longer feeling the pull of the normal negative pressure. When the chest is half full of fluid the lung is crowded into the upper half of the thoracic cavity and is pressed toward the mid line. With greater amounts the lung shrinks down to a small mass of unaerated tissue near the hilum. Fortunately, the blood supply from the pulmonary artery is shut off at the same time as the air, and practically all the blood from the right heart goes through the unaffected lung. Therefore, there is no mingling of unaerated with aerated blood and cyanosis is not a prominent symptom. There is, of course, some embarrassment of respiration because the heart and mediastinum are pressed toward the unaffected side. The functionating tissue is diminished by one half, but this is usually within the factor of safety for this organ, and there need not be much distress when the subject is at rest. Symptoms can appear with great rapidity if he increases the demand for oxygen by exercise, such as walking up stairs. Dyspnea may even be present when the man is at rest if his heart and remaining

lung are not in good order, or if he is suffering from anemia or fever.

One of the most dramatic causes of dyspnea is a spontaneous pneumothorax. A man who appears to be in good health suddenly feels a pain in his chest and becomes distressingly short of breath. He has ruptured a small abscess or tuberculous area, or even a normal vesicle on the surface of the pleura and the air has escaped into the pleural cavity until the lung has shrunk into a small airless mass near the hilum. The heart and mediastinum are displaced, the diaphragm is depressed on the affected side, and the intercostal spaces may be bulged outward by the unaccustomed positive pressure within the thorax. The symptoms are acute and urgent because the body has not had time to accustom itself to the new conditions. If an artificial pneumothorax is produced gradually the symptoms are no greater than in the case of a pleurisy with an effusion. Many patients with tuberculosis confined to one lung are greatly benefited when this lung is kept at rest by means of injections of air into the pleural cavity. These are repeated every few weeks, as the air is slowly absorbed, and the pneumothorax may be maintained for a year or more.

The total volume of respiration is practically unchanged by the induction of such a pneumothorax, provided that the remaining lung is in good condition. This means that the ventilation in the healthy side is perhaps doubled. Such a pneumothorax may relieve a dyspnea due to the circulation of blood through a diseased and unaerated portion of the lung.

If ordinary air is used for the insufflation, it tends to come into equilibrium with the gases contained in the alveoli of the lung. The soluble, readily diffusible $CO_2$ passes into the pleural cavity until it reaches about 7.5 per cent, while the excess oxygen of the insufflated air diffuses more slowly into the lung. As a result, the volume of the pneumothorax increases for about an hour and the patient may suffer his greatest distress at this time. This could perhaps be obviated if the pneumothorax were produced by means of a mixture approximating alveolar air in its composition.

Matters are quite different when there is an open communication between the pleural cavity and the outside air. Here the size of the opening in its relationship to the size of the glottis is of greatest importance. During inspiration the air rushes into the pleural cavity through the artificial opening which competes with the normal channel via the glottis into the interior of the lungs. Evarts Graham (3) states that some air will enter the lungs, even if there are openings in both chest walls with a combined cross section greater than that of the glottis. He has shown that life is possible under such

conditions and has removed some of the apprehension that was caused by the rare necessity of operating on both pleural cavities.

Normally there is a negative pressure in the pleural cavity amounting to 5–9 millimeters of mercury at the end of inspiration and 3–7 millimeters at the end of expiration. With a small opening in one chest wall the air enters and causes a partial collapse of the lung, with a deviation of the mediastinum to the otherwise unaffected side. Graham states that with moderate changes there is not very much difference between the pressure on the two sides. He points out the fact that a unilateral open pneumothorax will result in death if the opening be made sufficiently large, and insists that the important factor is the relationship of the size of the opening to the vital capacity of the patient.

Every pneumothorax encroaches upon the factor of safety in the lungs. If other abnormal conditions, such as pneumonia or heart disease or general toxemia, have already lowered the vital capacity, they have pari passu diminished the factor of safety. A normal man with a normal vital capacity can tolerate a wide opening in his chest; a patient toxic in pneumonia and with several lobes consolidated runs a grave danger in any thoracotomy. Surgeons learned this by bitter experience during the influenza epidemic. They now try to wait until the pus has been walled off and the peak of the toxicity has passed before draining an empyema, and they usually make every effort to close the opening, or at least diminish its size.

There are several factors outside of the pleural cavity which can diminish the amount of air entering the lungs. Any constriction to the lower ribs or abdomen will diminish the vital capacity. When planning military equipment it is necessary to bear this important point in mind. In civil life women could formerly tolerate tight corsets during their ordinary activities, but they could not exercise in them. A similar embarrassment to respiration is furnished by abdominal obesity, particularly when the subject is flat on his back. The presence of large amounts of fluid in the abdomen have a similar effect, pressing the diaphragm much higher than normal. Here the semireclining position of the body affords some relief by draining more of the fluid into the lower abdomen where it does less harm. Even in this position, the arched and distended abdominal wall presses against the lower ribs.

Gas in the intestines, if excessive in amount, is almost as bad as fluid. There is no more distressing complication of pneumonia than abdominal distention. In typhoid fever the same amount of gas causes less trouble because there is no consolidation of the lung and not so much damage to the circulatory system.

*Lobar pneumonia*

Lobar pneumonia is a disease in which all parts of the hæmato-respiratory system are affected. There are changes in the lungs, blood, and circulatory system. The most striking change is the consolidation of one or more lobes with an exudate which fills the alveoli and blocks the entrance of air. In the early stages of such consolidation many of the blood vessels may remain patent and serve for the transmission of a considerable amount of unaerated blood which leaves the lobe in very much the same condition as it was when it left the right heart. This blood, low in oxygen, high in carbon dioxid, mingles in the left heart with blood from the unaffected lobes. The mixed arterial blood is therefore low in oxygen. No amount of superventilation of the good lobes can cause any significant increase in the oxygen of the blood which passes through them and they can not compensate for the deficiency caused by the consolidated lobe. They can, however, diffuse off more $CO_2$ than normal, on account of the shape of its dissociation curve, and this more or less compensates for the loss of function in the bad lobe. There results a condition of anoxemia which is often very striking and very detrimental to the general welfare of the patient, making him less resistant to infection. Meakins advocates the administration of oxygen to every pneumonia patient, starting early in the disease. He uses a face mask for this purpose, cleaning it at frequent intervals.

In the early stages of pneumonia the pain of the pleurisy leads to rapid, shallow breathing, and this in itself tends to produce oxygen want. The air of the dead space assumes a large share of the total ventilation and the proportion of fresh air breathed at each inspiration becomes smaller.

In the later stages of pneumonia the circulation of blood through the areas of gray hepatization almost ceases. There is no longer any significant mingling of unaerated with aerated blood, but by this time other factors have assumed greater importance. The prognosis in lobar pneumonia is largely dependent on the amount of lung tissue involved and on the general physical condition of the patient. If several lobes are involved there is a considerable encroachment on the factor of safety. The circulatory system may also suffer from the toxemia. There may be enough bronchitis to interfere with the aeration of blood in portions of the lungs which are not consolidated. In the final stages, edema of the lungs may complete the picture.

There does not seem to be any significant change in the dissociation curves of the hemoglobin for oxygen and carbon dioxide and it is doubted if methemoglobin or sulphhemoglobin plays any important part in causing the cyanosis. The cyanosis is proportional

to the extent of the oxygen unsaturation. In some cases of pneumonia the hemoglobin in the arterial blood is only 80 per cent saturated with oxygen as contrasted with the normal 95 per cent. Such patients usually show marked cyanosis. As a rule there is no increased retention of $CO_2$, but when this is present it tends to dilate the capillaries and increase the depth of the blue color.

The lack of oxygen has a deleterious effect on many important organs of the body, notably the brain and respiratory center. Meakins (4) performed an experiment on himself, inhaling nitrogen until the oxygen saturation of the arterial blood was acutely reduced below 80 per cent. Mental confusion and spontaneous incoordination appeared, but commands were automatically obeyed. This resembles the mental state of pneumonia patients seriously ill and it also reminds us of the phenomena of oxygen want in aviators.

The effect of oxygen want on the respiratory center is even more disastrous. At first there are efforts at increased breathing, but finally the respirations become rapid and shallow and there is no longer any response to an increase in $CO_2$, the one substance that always produces an immediate answer from the normal respiratory center.

Respiratory phenomena in lobar pneumonia, broncho-penumonia, and bronchitis are complex and are the resultants of many factors. We must remember that we may be confronted with the picture of oxygen want or of oxygen want plus increased carbon dioxide in the blood. This causes great dyspnea and cyanosis. We may have oxygen want with low carbon dioxide in the blood. This causes an ashen gray color with little dyspnea, and the patient may feel no more distress or apprehension than is found in the anoxemia of aviators or of men poisoned with carbon monoxide. Finally, there are the other factors of limited depth of respiration due to pain in the chest, or empyema or distended abdomen. There is the distress caused by coughing, delirium, or too frequently repeated physical examinations by physicians, all being factors which increase the demand for oxygen by the tissues.

### *Emphysema*

Emphysema is a condition very commonly found as an accompaniment of chronic pulmonary diseases of all sorts. The exact cause is unknown but seems to be associated with an inherited defect in the elastic tissue of the lung and augmented by any factor which causes increased expiratory efforts. The walls between the alveoli become thinner and many disappear, thus making large blebs and diminishing the alveolar surface and also the capillary bed. The elastic tissue is partially replaced by fibrous tissue. This process affects

chiefly the very portions of the lungs which usually distend most with respiration, namely, the lower and anterior margins. This causes a widening of the lower thorax with flaring of the ribs and a marked diminution in their excursions. The patients show chronic cyanosis, often of extreme degree. They are fairly comfortable except on exertion.

It is obvious that there are many factors which interfere with the respiratory function. The diminution of alveolar surface area, the loss of capillaries, and the thickening of the alveolar walls all tend to cut down the exchange of gases. Even more important is the loss of elasticity in those portions of the lungs which should be most expansile. The lungs no longer distend on inspiration like an accordion because their lower portions now resemble a distended paper bag. There is less churning and mixing of air in the lungs and a stagnation results in the alveoli. These contain a higher percentage of $CO_2$ and lower percentage of $O_2$ than normal. Since the process is only gradually progressive the body has time to adjust itself to this bad atmosphere. The oxyhemoglobin dissociation curve shifts slightly to the left and thus permits the hemoglobin to absorb more oxygen from the alveoli than would be the case with normal people whose alveolar oxygen was at the same low level. This effect is aided and abetted by the increase in hemoglobin which usually accompanies emphysema. There is also an adjustment to the chronic retention of $CO_2$, and the tendency toward gaseous acidosis is compensated by an increase in the bicarbonate reserve. The body seems to accustom itself to the higher percentage of $CO_2$ in the tissues.

When a normal man breathes increasing percentages of $CO_2$ the respiratory center responds by a steadily increasing total ventilation of the lungs accomplished chiefly by an increased depth of each respiration, since the rate tends to increase only when the maximum depth of respiration for that individual has been reached. In emphysema an increasing percentage of $CO_2$ in the inspired air has relatively little effect because the subject is accustomed to a high $CO_2$ content in alveolar air and tissues. Finally, however, when the patient has reached a $CO_2$ percentage somewhat higher than his accustomed level he tries to respond by greater respiratory efforts. It is difficult for him to secure any greater depth of respiration on account of the loss of elasticity of lungs and chest wall. His respiratory distress then suddenly becomes even more acute than that of the normal man.

### *Pulmonary tuberculosis*

In the mild case of pulmonary tuberculosis with only slight lung involvement there is no reason to expect respiratory changes other

than those produced by fever. Even in some of the cases with extensive pulmonary involvement there is little change in the oxygen and carbon dioxide content of the arterial blood. Other cases may show marked divergences from normal and the respiratory finding may be as varied as any of the other phenomena of this disease.

Dautrebande, according to Meakins (4), has studied the blood gases of a number of patients with tuberculosis. In most of them the oxygen saturation of the hemoglobin was practically normal. In one man whose condition was going steadily downward the saturation fell from 97 per cent to 84 per cent the day before his death. This was complicated by a marked anemia (Hb. 42 per cent) and the tissues must have suffered from oxygen want. It is interesting to note that in this patient the ordinary methods of physical examination of the chest failed to reveal any anatomical changes during this period of marked physiological change.

In the modern treatment of pulmonary tuberculosis great efforts are made to secure rest for the affected lung or lungs. If only one lung be involved we can resort to the method of artificial pneumothorax already described, or can cut the phrenic nerve on that side in order to paralyze that half of the diaphragm. A spontaneous pluerisy with effusion may have a similar effect. Some say that it is also possible to rest one lung by having the patient lie on a flat bed on the affected side with a pillow under his lower ribs. The ordinary bed sags in the middle and the patient lying on one side usually has his head and shoulders on the pillow. This curves the middle of the spine downward and compresses the ribs on the upper side of the body. Such a patient does most of his breathing with the lung nearest to the bed.

The respiratory excursions of both lungs are kept at a minimum when the patient is under basal conditions, motionless in bed and without the stimulus of food. There is evidence to show that the metabolism is not increased when the patient lies propped up in bed. McCann (5) has studied the effect of foods on the respiration. All food has some specific dynamic action in increasing the total metabolism. This is very slight in the case of fat, but protein or carbohydrate in large amounts can increase the metabolism 20 to 30 per cent for several hours. Carbohydrate metabolism is characterized by a particularly large $CO_2$ elimination in relationship to the $O_2$ consumption because its quotient is unity (1.00). Since $CO_2$ is the chief stimulant to respiration the effect of carbohydrate is particularly marked. The lesson drawn from this by McCann is that if we wish to keep the work of the lungs as low as possible we must avoid excessive amounts of protein and especially carbohydrate. The diet for tuberculosis should contain a relatively large proportion of fat and it should not be greatly in excess of the caloric requirements.

### *Anemia*

With sudden loss of large amounts of blood the respiratory distress may become very great before half the hemoglobin has left the body. On the other hand, in a slowly progressive anemia the hemoglobin may drop to 30 to 40 per cent of the normal before the patient is forced to stop work and he may be quite comfortable in bed with only 15 per cent hemoglobin.

If we analyze the arterial blood in a moderately severe case of anemia, with, say, 35 per cent hemoglobin, we find the percentage saturation with oxygen at about its normal level, 95 per cent. The tissues are bathed in plasma and it is the oxygen of the plasma that counts. Now this depends not on the total amount of oxygen in the blood but on its percentage saturation and we have just seen that this is normal. Therefore the fluid that is sent to the cells bathes them with a normal tension of oxygen. This must, however, be diminished rapidly because the total amount of oxygen carried is small. In the patient with 35 per cent hemoglobin each 100 cubic centimeters of blood carries only 35 per cent of the normal amount of oxygen. Normal blood is usually robbed of almost a third of its oxygen in passing through the tissues. Therefore the patient with 35 per cent hemoglobin could supply just about enough oxygen if his blood were completely deoxygenated in its passage through the capillaries.

This would not give much leeway for exercise. The patient with less than 30 per cent hemoglobin would require additional means of adaptation. There is usually an accelerated pulse rate in anemia and probably an increased blood flow per minute. Perhaps this is helped by the diminished viscosity of the blood. It would seem also as if the tissues were able to acclimatize themselves to the lowered oxygen tissues and carry on their functions at a low but fairly efficient level.

### *Cardiac disease*

In cardiac disease the amount of respiratory distress depends chiefly on the congestion of the lungs. This in turn depends largely on the efficiency of the myocardium. One factor in producing damage to the myocardium is lack of oxygen due to interference with respiration. This completes a vicious circle.

Little or no effect on respiration results from a few premature beats or ventricular extra systoles. There may be no change in the percentage saturation of oxygen of the arterial blood in a case of marked tachycardia or auricular fibrillation. There may be striking valvular lesions with loud murmurs and still no change in the oxy-

gen saturation or carbon dioxide content of the blood. If the myocardium is strong enough to maintain compensation there may be no respiratory symptoms.

As soon as the cardiac irregularity, or valvular lesion, or damage to heart muscle progresses to a point where the circulation is impeded respiratory trouble makes itself manifest. If the blood tends to collect in the pulmonary circuit, the blood vessels, particularly at the bases, are congested, and the capillaries encroach upon the alveoli, which may be more or less filled with fluid. This causes stagnation of bad air in parts of the lungs and increases the distance between the blood in the pulmonary capillary and the air refreshed at each tidal respiration. Such an interposition of fluid and dead space makes it particularly difficult to maintain the absorption of oxygen. Carbon dioxide is so much more soluble in fluids that its elimination is not nearly so much hampered. Another factor which helps the elimination of $CO_2$ is the shape of its dissociation curve. Thus it may happen that with pulmonary congestion or edema there may be a very considerable diminution in the oxygen saturation of the arterial blood and at the same time a normal or even diminished carbon dioxide content.

With the more serious grades of auricular fibrillation or mitral stenosis or myocardial weakness the stage of decompensation is usually accompanied by a decreased rate of blood flow. Thus, some patients whose blood flow is normal at 7 to 8 liters per minute when compensated, show only 3.5 to 3 liters per minute when suffering from cardiac failure. With this slowing of the general circulation the blood is more completely robbed of its oxygen in the systemic capillaries and comes back to the lungs very low in oxygen and very high in $CO_2$. The lungs are congested and have great difficulty in diffusing the $CO_2$, and even more difficulty with the $O_2$. In such a case the saturation of oxygen in the arterial blood may fall to 85 or even to 75 per cent. The carbon-dioxide content may rise, but if there has been sufficient increase in pulmonary ventilation the $CO_2$ may be normal or even diminished. As a rule there is not much change in the shape of the dissociation curve, but Peters and Barr (6) have found some cases in which the $CO_2$ curve is flatter than normal. The change in the $_pH$ of the blood does not seem to be an important factor in most cases of decompensation.

Mechanical factors tend to limit the efficiency of respiration. The vital capacity is decreased in heart disease, and the extent of this is roughly proportional to the degree of decompensation. Binger has shown that the total lung capacity is relatively smaller than in normal individuals, and that the mid-capacity and residual air form relatively larger portions. The diminution affects chiefly the reserve

and complementary air. This means that the depth of respiration is sharply limited, and even if it be sufficient to meet the needs of the patient at rest it can not accommodate itself to the increased demands of exercise. This is due largely to the congestion of the lungs, with its decrease in alveolar capacity, or perhaps to a restriction of the points of the Hering-Breuer reflex. There is some evidence which points to a decreased elasticity of the lungs due to vascular turgescence.

In addition to all of these the patient may be suffering from a collection of fluid in one or both pleural cavities or in the abdomen. In many cases the liver is greatly increased in size, and its tenderness may be a factor as well as the abnormal distension of the intestines with gas. The impairment of the circulation and the resulting anoxemia damage to a certain extent all of the tissues of the body. This is well illustrated in the response of the kidneys to the effects of digitalis. When a sufficient amount of the drug has been given to improve the circulation the urinary output, which may have been less than half a liter a day, suddenly increases to 3, 5, or even 10 liters a day as the edema is removed like magic.

Congenital heart disease is a chapter by itself. The condition is far from common, and it is rare to find adults with enough disturbance in the circulation to cause dyspnea and cyanosis. If there is a large communication between the ventricles or between the aorta and pulmonary artery, we might expect a shunt which would allow some of the blood to enter the systemic circulation without having passed through the lungs. Apparently this does occur in a few cases, but it is difficult to see why the blood should flow from the pulmonary circuit with its low pressure into the aorta, where the pressure is much higher. It is possible that the pressure relationship may be changed by stenoses.

[To be continued]

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## MEDICAL ASPECTS OF NAVAL AVIATION

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### Foreword

Aeronautical development during the last two decades has been remarkable, and, coincidently with this progress, medical officers have found it necessary to study various mental and physical problems peculiar to aviation. Aviation medicine now is in the pioneer stage, but is rapidly becoming an essential and important branch of preventive medicine. It embraces finding and eliminating casualty-producing factors among fliers.

Man has been adjusting himself to constantly changing environments and combating disease to prolong life and make it happier by physical improvement. Men are now adjusting themselves to unusual conditions found only in the air; they are in an unnatural element. Remarkable advances have been made by aeronautical engineers in the design and construction of planes and engines, but only recently has serious consideration been given to flying personnel. It is only since the end of the World War that attention has turned to aviation medicine in an attempt to reduce the casualties incident to flying.

The question is often asked, "What is a naval flight surgeon?" A flight surgeon is a medical officer in the Navy who has been found qualified for aviation duty upon the completion of a special course of study at a recognized school for flight surgeons. The course, which requires three months for its completion, comprises the following subjects: Physiology of the respiratory and circulatory systems of the aviator exposed to high altitudes; lectures, clinics, and practical work upon organic and functional heart diseases; lectures and clinics upon neuropsychiatry, with emphasis on personality study; lectures and clinics upon eye, ear, nose, and throat diseases. Special apparatus for examining candidates is demonstrated, and practical demonstrations in the use of the rebreather and the low-pressure chamber in studying the problems of altitude reactions are given. Finally, a study is made of a standard mental and physical examination for selecting the flier.

A few of the conditions and difficulties experienced by fliers are, briefly: (*a*) Staleness of fliers (neurocirculatory asthenia, physiological fatigue, effort syndrome, soldier's heart, irritable heart). (*b*) Aviation sickness (air sickness, air nausea, balloon sickness). (*c*) Altitude sickness (mountain sickness). With a knowledge of these, and the elimination of those causes tending to produce physical unfitness of the flier, aviation medicine will unquestionably be instrumental in decreasing the number of crashes and fatalities. The flight

surgeon must protect the aviator—"the heart and brain of the airplane."

The duty of the flight surgeon not only is the selection of the mentally and physically qualified, but includes the more important function of maintaining the aviator in the proper physical condition. An aviator must be kept in a fit mental and physical condition and must be relieved promptly from active flying (handling the controls) when signs and symptoms of trouble become evident. Otherwise much loss of life and Government property would result. In addition to these paramount duties, the flight surgeon should be encouraged to fly to obtain appreciation of flying psychology and a true perception of the stress and strain to which fliers are exposed. He should also actually experience the symptoms induced by flying at high altitudes and those that follow prolonged flights. The flight surgeon attends crashes, gives urgent medical aid, and transports the injured in airplanes to the nearest hospital. He accompanies air squadrons operating from ships and air bases and makes inspections of outlying units. His willingness to fly will ultimately improve the morale and gain the confidence of the fliers. By actual flights medical officers are afforded opportunities to develop and perfect equipment which may be useful in safeguarding the lives of aviators.

### Selection of Medical Officers

Careful consideration should obtain in the selection of medical officers for aviation duty. Aviation medicine is a specialty, and a medical officer should have naval experience before being assigned to a course of instruction in it. Moreover and primarily, when a medical officer is selected the principal question to be considered is whether he can and will adapt himself to the practice of this new medical science.

The main effort of the medical officer should be to acquire the confidence of the fliers under his supervision. The medical officer should live and eat with the fliers, as doing so affords an excellent opportunity for him to learn many things about them which can not be learned in any other way. He should be able to speak the flying language. He should use great tact in discussing the flying abilities of different aviators, particularly so when mistakes which result in crashes are made. No pilot cares to be informed of his mistakes unless it be done by someone who is qualified to criticize.

Personality is an enigma. Time is extremely necessary before a medical officer can ascertain with any degree of certainty the temperamental qualities of his fliers; whether they are the sanguine, optimistic, phlegmatic, bilious, pessimistic, eccentric, or conservative

types. Moreover, the medical officer will be materially aided in arriving at some conclusion of the true psychic "make up," or character, if he has the confidence of the flier. This understanding is further enhanced when the medical officer shares the troubles confronting the fliers and interests himself in their behalf.

As a result, the medical officer will have some knowledge of the temperamental character of his flier. The medical officer can estimate his normal behavior under the usual daily stresses, whether he be eccentric, optimistic, or conservative, and so forth. By daily observation he can mentally note any change from the normal line of behavior. By this method, early signs of staleness can be detected and later confirmed by tests prescribed for this purpose. It is an arduous and painstaking task. As a result of such observation, however, and with advice and suggestion for relaxation and rest, it will be appreciated that a flier can be protected from an injury which may result from a crash. No flier is immune from crashes, but one can not afford to endure too many of them.

Therefore, to get an understanding of the flier, the medical officer must truly have a personality which shall suit him for this type of duty. It is believed that not every medical officer can adjust himself in this environment. No truer statement is made than that "there is no other phase of military service wherein there is such close observation of personnel as that which presents itself in aviation."

Finally, the medical officer should be given adequate opportunity to acquire actual flying experience. He must fly in order that he may understand air conditions and troubles incidental to aviation.

### Establishment of Safety Pilots

A definite plan has been developed by the flight surgeons to be followed in the selection of officers for aviation duty involving actual control of aircraft and in the maintenance of physical fitness of naval aviators. Nothing has been determined as to the length of time a flier can perform his duty as an active pilot in actual control of his aircraft. Probably an opinion can be rendered by the older pilots and the flight surgeons of the naval service as to how long a time they conscientiously believe the average pilot should be active in the performance of flying duty.

It appears that there are two kinds of aviation duty involving flying in the naval service, active and inactive flying duties. Active flying duties do not necessarily mean flying around an airdrome under suitable weather conditions to get in flying time. I would understand active duties to be flying away from a base of operation, as in the cross-country hops, airplane races, bombing, torpedoing, and scouting, combat fighting, testing airplanes, experimental work, and nonstop flights of from two to six hours. Inactive flying duties

would include inspection of aircraft and engines at different plants, aircraft design and construction, bureau and air station duties, duties of flight deck officers of carriers, and heads of departments aboard aircraft carriers and tenders.

Is it not so that aviation is a young man's game? How often will a flier admit that he is no longer young? A crash, an unexpected thrill, or an injury, will often produce a profound impression upon the older pilot. When alone, such a pilot will most likely ponder in his thoughts—"Shall I quit flying? What will my shipmates say?" and his pride will conquer him and he will continue to fly. Would such a pilot admit that he has reached the limit as an active flier and continue flying henceforth with a safety pilot? That is the question to be decided by the pioneers of naval aviation and other authorities.

Flying is a young man's game. After a flier wins his wings he has only begun to fly. As he progresses, he is not only mastering the art and technique of flying an airplane under any condition, but, far more important, he is becoming proficient in the tactical purpose of flying, such as combat flying, spotting, scouting, bombing, and torpedoing, patrol and reconnaissance, and other offensive problems against the enemy. After many years of strenuous flying in the various capacities mentioned above, the flier has undergone severe, constant mental and physical stress and strain. Is it not advisable that such a flier shall be entitled to a safety pilot if he is to continue active aviation duty involving flying? It is a difficult and sometimes delicate problem to confront the pilot with the information that he is no longer young and elastic, and that he has reached the age limit of his efficient flying abilities.

At the present time there is no definite plan, and it is human that an aviator will continue flying until he is severed from it by a permanent disability or death. With the establishment of safety pilots, our older naval aviators can be protected and needless accidents avoided.

After several years of observation and study of naval aviators, both on the ground and in the air, for a period approaching 400 hours, and in view of the preceding paragraphs, the following recommendations are made:

(1) That when a flier has reached the age of 40, and particularly if he has had from 12 to 15 years of active flying duty, the time has arrived when he shall stop flying as an active pilot in actual control of aircraft. If he is to continue active aviation duty involving flying he shall do so only when accompanied by a younger pilot who shall be considered the safety pilot.

(2) If a flier is not selected to continue active aviation duty he shall be assigned to inactive aviation duty involving flying. The older and more experienced pilots will be needed as squadron commanders, wing commanders,

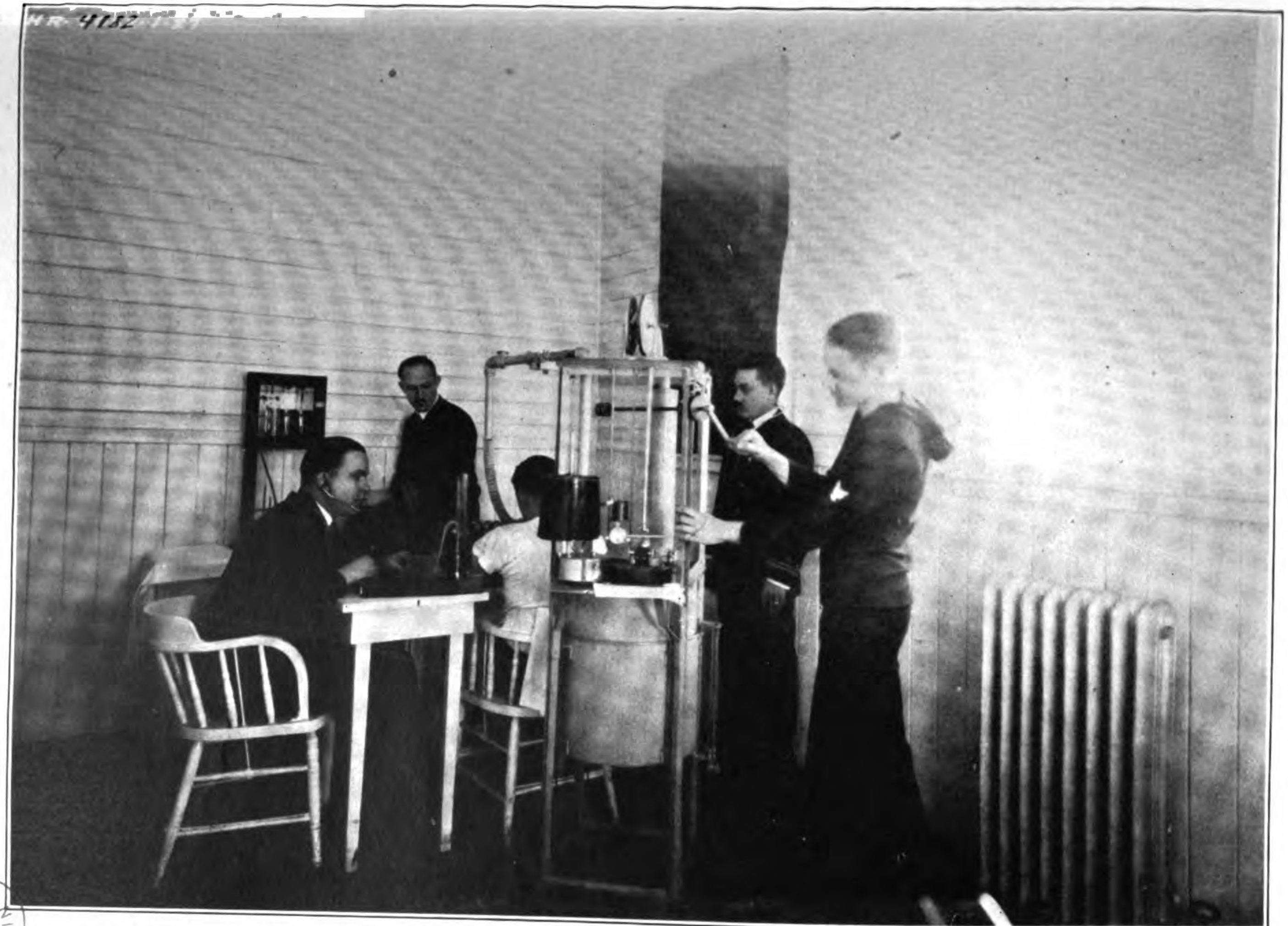

FIG. 1.—TESTING THE CEILING AND PHYSICAL FITNESS OF AN AVIATOR BY THE REBREATHER METHOD

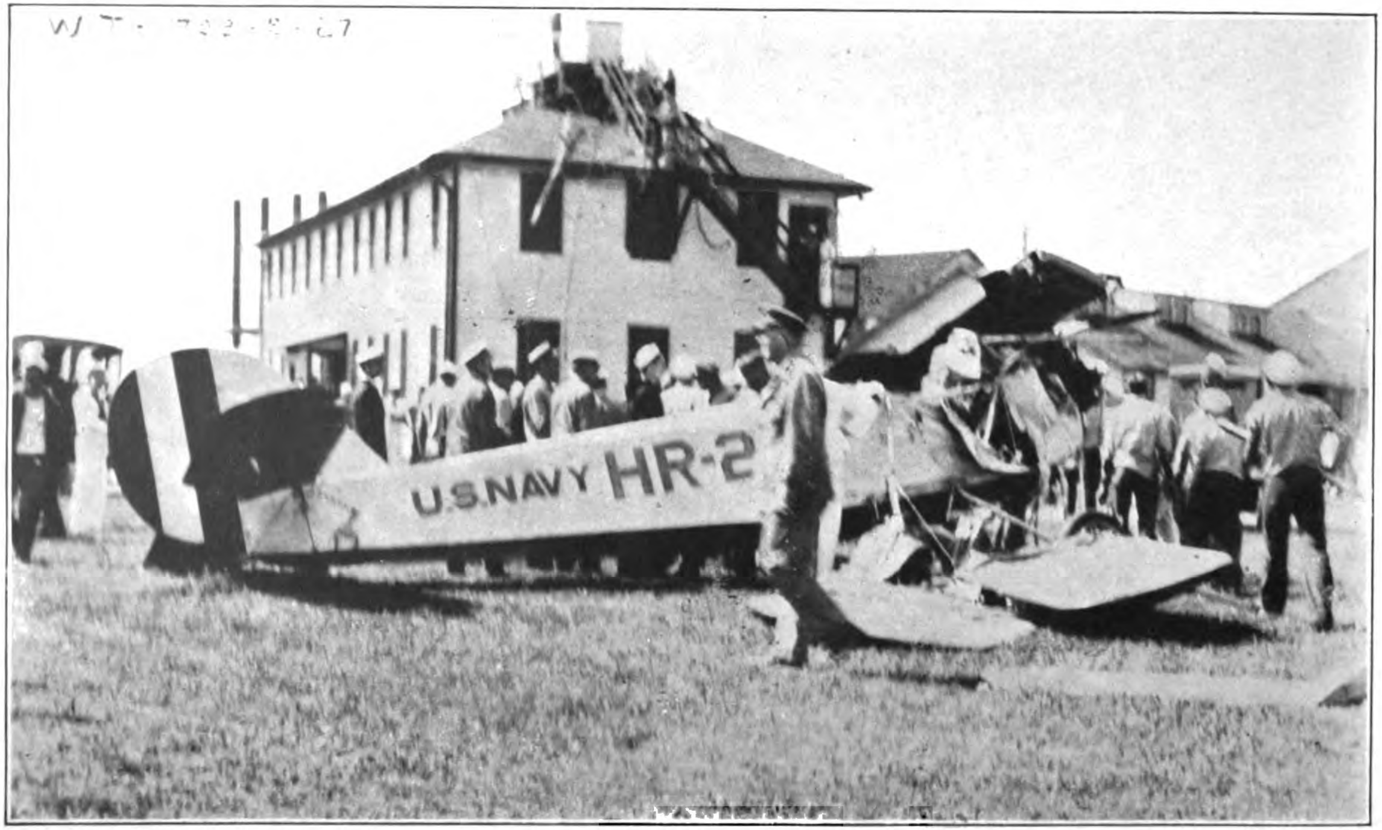


FIG. 2.—CRASH DUE TO HITTING AEROLOGICAL MAST IN APPROACH TO LANDING FIELD

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**group commanders, and still older pilots for other positions of administrative and operative character, both afloat and ashore. Old, experienced naval aviators are a necessity to the progress of naval aviation. Why not protect them?**

THE PSYCHOLOGICAL FITNESS OF A CANDIDATE FOR AVIATION TRAINING

The problem of determining in the short time available whether or not an individual is temperamentally suited for flying is at times a difficult matter for the medical officer, and may be a delicate matter of much personal consequence to the examinee. Some of us have fluctuated in our ideas, from the conviction that very few persons possess anything like the most desirable characteristics, to the view, formed in disgust and a feeling of personal failure, that really the vast majority of mankind can learn to fly satisfactorily after all.

As a matter of fact, from the service point of view, a certain limited number of men present themselves for aviation training, and it is up to us, where definitely disqualifying physical factors are not ascertained, to gauge the relative abundance or scarcity of applicants and to choose from these the men best suited, and in sufficient numbers to fill the need. To the isolated flight surgeon this would naturally require information difficult or impossible to obtain. For this reason, as well as for the apparent reasons stated in a recent circular letter to flight surgeons, we heartily indorse the bureau's policy of evaluating and summing up in Washington the results of the psychological examinations.

One commanding officer of an aviation unit very pointedly asked how, when we asked all these questions relating to a candidate's history and emotional experiences, we knew he answered us truthfully. To detect the false, to separate it from the truth which may have to battle its way to conscious expression, is not always so easy as some may think. In our work we would have no faith at all in the criminologist's lie detector. If we ever see a candidate with all possible complexes in apparent perfect sublimation we'll be tempted to suspect catatonic precox. Furthermore, in our observation, the young man without any worries and with not a conflict, is most decidedly a "dub." The only question is, "Are these psychic phenomena present to a definitely pathologic degree?" This we can usually ascertain fairly readily, and here we should like to emphasize the preponderant importance of a carefully taken history.

We are convinced of the extreme rarity of essential change in mental make-up, general trends, fundamental aspirations, after 18 years of age. The means to the end may, indeed, vary endlessly; that is important, but not so important as the impelling motive.

A frequent pitfall is encountered in the case of the individual who seems to have inferiority written all over him. It will often surprise you to find out what his intimate associates think of him. Do

not be too hasty in judgment. The weak are often the strong. And adversely, though truly, many of our best pilots are decidedly overcompensating for definite and fundamental inferiority.

And so, when a young man comes to us as a candidate for aviation training we try first of all to make friends with him. It is best to try really to feel friendly. Listen sympathetically, help him all you can; don't be "hard boiled"; don't drive him. You can soon learn how he got his start and what he did with it. And if you have his confidence, and he feels at ease, his facial expression and mannerisms will tell you as much or more than his words.

Generally, you will find him to be a perfectly desirable individual.

There are two fundamental requirements that should never be overlooked—first, enthusiasm (not the hectic fly-by-night kind, but a well-considered, definite desire to fly), and, secondly, perseverance. Men possessing these attributes who have records of tolerable success in early life, who have had no lapses in a purposeful drive toward their fixed ends, should be considered desirable aviation material.

### Naval Aviation Accidents

Accidents will continue to accompany high-velocity forms of transit, and attempts are constantly being made to reduce their incidence to a minimum. Loss of life and injury to personnel usually follow such accidents. Crash boards and trouble reports cover all crashes in naval aviation, with the ultimate aim of making flying safer, by ascertaining, studying, and correcting the possible causes. Sometimes accidents are unexplainable. In addition, flight surgeons, although they are not members of crash boards, are urged to study accidents and forward crash reports, with their opinion of the factors contributing to the production of crashes.

It will be appropriate to study the percentages of crash-contributing factors in the summary of naval aviation crashes for the fiscal year 1925–26, compiled by Commander R. G. Davis (M. C.), United States Navy.

*Percentage of crash-contributing factors*

| Causes | Per cent | Causes | Per cent |
|---|---|---|---|
| Due to pilot | 48 | Fire | 2 |
| Field or terminal | 30½ | Catapult | 1 |
| Power plant | 21½ | Night flight, training | 1 |
| Structural failure | 17 | Arresting gear | ½ |
| Weather conditions | 12 | Faulty design | ½ |
| Collision in air | 4½ | Passenger interference | ½ |
| Flight deck of carrier | 3¾ | | |

From this list two factors are outstanding: First, the mechanical features (structural defects and engine failure), and secondly, and most important, the man who flies the machine. The designers and

engineers are increasing the mechanical efficiency of the airplane, with the main thought directed not only toward enhancing its military value but also toward making each successive model safer for the flier. The flight surgeons are selecting with utmost care the men who shall fly, and they are maintaining them at a high mental and physical standard.

The above statistics show that 48 per cent of crashes are due to the pilot. Let us assume that the man who flies the machine is responsible for the crash. What causes him to crash, and what remedy can be offered to prevent him from cracking up?

When crashes are attributed to the pilot, poor judgment is the paramount cause. Poor judgment covers a multitude of mishaps. The following factors, in order of importance, can be classified under poor judgment: (*a*) Inexperience, (*b*) neglect to take proper precautions for aerial navigation (weather conditions), (*c*) disregard of well-established aerial practice, (*d*) disobedience of flying rules, (*e*) mental depression.

The majority of accidents resulting from inexperience on the part of the flier are supplied by the Naval Reserves. The following practice is usually the rule: A Naval Reserve flier is ordered to an air station for training for from two to four weeks, is checked out in the *routine* manner, and is then left alone to fly, after having been absent from active flying for a period of months. Furthermore, he gets whatever plane happens to be available, from a slow training plane to a fast observation plane. If he averages 10 to 20 hours in 15 days he is indeed fortunate. After such a period of training he is discharged to inactive duty for another year. It is very important that a flier be *thoroughly* familiar with the type of plane which he flies. All planes fly alike, but different types have their peculiar flying qualities.

It is not uncommon to have a passenger take a trip into the air. It may be his first ride and just how he will react is unknown. It is advisable that the passenger be placed in the forward cockpit for his first ride, where he can be under the observation of the pilot. There are numerous incidences of accidents resulting fatally, cause unknown, when the passenger rode in the after cockpit. One never knows what he may do when he gets into a sudden, peculiar position. He may become terror stricken or panicky and seize anything available for support. He may lose his seat temporarily, the cushion slipping from under him and interfering with the controls. Various other factors may arise and interfere with the flight of the plane, resulting in nose dives, tail spins, and so forth. With the passenger seated forward, particularly on his first trip, he comes under direct observation of the pilot and, if he becomes unduly agitated, any necessary action is instantly taken.

Too frequently no attention is paid to weather conditions, one of the most important precautions in aerial navigation. Very often the flier takes off in the face of a storm, attempting to fly around, through, or above it to his misfortune. Sometimes he leaves knowing fully well that it will be dark before half the journey is through, and all that is necessary for a potential crash is an engine failure. The parachute may well be his only salvation. Weather conditions are as important as the revolutions per minute, oil pressure, water temperature, and other gauges of safe flying. If weather conditions are such as to make flying unsafe it is quite imperative that a plane shall not be permitted to leave.

Disregard of well-established aerial practice and disobedience of flying rules about an airdome have their victims. Stunting at low altitudes, or in machines not made for stunting purposes; failure to make a careful check of instrument readings to assure oneself that the engine is properly heated; failure to look behind before taking off; failure to check controls (crossed controls); returning to the field after take-off without sufficient altitude; failure to land immediately when engine or structural trouble is detected, in a favorable field, trusting to luck that the defect will not be a vital one; landing down wind or cross wind; failure to check on quantity of gas, oil, and water on hand, and the distance to cover; and various other primary rudiments of elementary flying are not adhered to as diligently as one might expect. Sometimes the pilot falls off in his diligence and leaves too much responsibility to the mechanic.

It is undoubtedly true that more accidents occur on cross-country trips than when regular routine operations are performed in naval aviation. Experience is essential to safe flying and cross-country work is the field in which to acquire it. Still, troubles do arise and why they occur is unknown. It is possible that the pilot is thinking of what to expect at the end of the journey. He is bent on getting there, anxious to arrive on time, and it is so easy to take one chance too many.

When a flier has lost flying enthusiasm he becomes careless. Carelessness produces crashes. The following causes will ultimately produce poor flying attitude: (*a*) Convalescence from disease or injury, (*b*) staleness (fatigue of the nervous system), (*c*) dissatisfaction with present station or duty, (*d*) undue excesses and faulty living, (*e*) delusions of persecution by superior officers, (*f*) failure to get along with brother officers, (*g*) financial difficulties, (*h*) sleepless nights, (*i*) anxieties regarding the family at home, (*j*) anxieties of everyday occurrences in human life. While the flier is in this condition he should abstain from flying and come under the observation

of the flight surgeon until such time as he has regained his proper flying attitude.

To prevent aviation accidents, remove the cause. Poor judgment on the part of the pilot produces the majority of accidents. How shall poor judgment be prevented? The flight surgeon realizes that a tired or sick mind and body can not handle situations in a prompt and satisfactory manner. A clear mind, quick reaction, and good judgment are mental faculties under the control of the nervous system. Poor judgment is seldom used by the physically and mentally fit and properly indoctrinated, experienced flier. If the pilot is indeed "wooden," rash, and narrow, with an exaggerated idea of his flying ability, he will either rapidly recover his equilibrium or meet his downfall. Sometimes disciplinary action will be the only remedy for this type of flier.

It is apparent that the main function and most difficult duty of the flight surgeon is the maintenance of the flier in a state of high physical, mental, and moral fitness. His training and indoctrination as a flier will come under another department. A combination of both will surely diminish aviation accidents.

### Physical Fitness of Naval Aviators

When naval aviators and aviation pilots report for duty in the aircraft squadrons, Scouting Fleet, they come under immediate attention of the flight surgeon. Before they are permitted to fly they are given a preliminary physical examination to ascertain their physical and mental condition. Following this, a brief history is taken of their duties in aviation, the number of flying hours, types of planes flown, and any groundings or crashes. The following forms are used:

Name------------------ {Rank / Rating} ---------------- Squadron---------------
Date reported----------from---------- Date detached----------to----------
Medical forms received---- {1. Health record / 2. NMS Form 1 / 3. NMS Form 2} ---- Forwarded to---- Receipt received----
Date last annual physical examination------------ Defects noted------------
Recommendation--------------------------------------------------------
Quarterly examination physical fitness: Circulatory index—
January 1-------- April 1-------- July 1-------- October 1--------
Flying time (approximate hours)---- Number of crashes---- Groundings---
Groundings present station---------------------- Cause--------------------
Sick list------ Cause--------- Number of sick days------ Sick leave------
Name of next of kin------------ Address------------ Religion------------
Remarks------------------------------------------------------------
 ----------------------------------------------------------------------

*Reexamination of aviator (upon reporting for duty)*

AIRCRAFT SQUADRONS, SCOUTING FLEET

Name_____________________ Rank_______ Age_____ Date reported____________

CIRCULATORY FITNESS

Reclining pulse______________________ Increase on standing________________
Standing pulse______________________ Increase after exercise_______________
Return to normal_____________________________________________________
Blood pressure reclining__________ Standing__________ Increase__________
Rating _____________________________________________________________

HEARING

Right ear: Watch________40 Coin click________20 Whispered voice________15
Left ear: Watch_________40 Coin click________20 Whispered voice________15

VISION

Visual acuity______________ Right eye______________ Left eye______________
Depth perception____________________________________________________
Muscle balance______ Esophoria______ Exophoria______ Hyperphoria______
Angle of convergence_________________________________________________
Prism divergence ___________________________________________________
Pupillary reactions___________________________________________________
Remarks ____________________________________________________________
____________________________________________________________________
____________________________________________________________________

_____________________________________
*Flight Surgeon.*

NOTE.—One copy to be forwarded to medical officer, aircraft squadrons, Scouting Fleet.

While on active flying duty the flier must keep himself in good physical condition by indulging in some form of exercise or athletic sport. The following order is in effect:

ORDER No. 3–27

File A2–11 (CAS–O.)

UNITED STATES FLEET,
AIRCRAFT SQUADRONS, SCOUTING FLEET,
U. S. S. "WRIGHT" (FLAGSHIP),
*Media Luna Cay, Cuba, February 4, 1927.*

Subject: Physical fitness of naval aviators, aircraft squadrons, scouting fleet.

1. It is paramount that the physical fitness of aviators in aircraft squadrons, Scouting Fleet, be kept at a high standard.

2. This physical fitness can best be maintained by the use of proper exercise. All aviators should engage in some form of exercise, whether it is swimming, walking, golf, tennis, medicine ball, horseback riding, or setting-up exercises. This exercise will improve the general condition of those so indulging.

3. It is apparent that good physical condition of a flier will produce good judgment, self-confidence, and mental alertness, which are necessary factors toward safe flying. Furthermore, it will result in less complaining of petty ailments.

4. A test for physical fitness (preferable circulatory efficiency index prescribed in article 1565, section "F" of the Manual of the Medical Department) shall be performed by the flight surgeon of all aviators actively engaged in flying at three-month intervals. If considered necessary the flight surgeon may at his discretion prescribe the test at any time.

5. A report in letter form shall be submitted by the flight surgeon via his commanding officer to commander aircraft squadrons if any aviator under his supervision has a circulatory index of 7 or below. It shall state the causes or any other information with recommendations pertaining to the case.

6. The commanding officers of the units of the aircraft squadrons, Scouting Fleet, will make certain that every opportunity possible is given the officers and men engaged in flying to exercise.

7. In a tropical climate it is advisable to exercise early in the morning or late in the afternoon and not during the heat of the day.

J. J. RABY.

Copy to all units.

The flier is given a physical examination every three months to ascertain his neurocirculatory fitness. A certain rating must be attained if the flier is to continue flying duty. If the circulatory index is below the rating of 7 the flier is automatically recommended for grounding and is placed under the observation of the flight surgeon until such time as he is again physically and mentally fit to resume his flying duties.

It is important that the flight surgeon shall recognize the insidious symptoms and signs of neurocirculatory asthenia ("flying staleness"). This is usually determined by history, temperamental changes, and a low neurocirculatory index of the flier. To be aware of such a condition the flight surgeon must familiarize himself thoroughly with the characteristics and manners of each pilot and make the flier realize that he is his family physician. By knowing his pilots intimately, the flight surgeon can detect any change from the normal and advise immediate treatment.

### CONCLUSION

Aviation medicine has assumed its importance in relation to other specialties of preventive medicine, and the necessity for flight surgeons is recognized. The flight surgeon can effectively apply a proverb of preventive medicine, "Every ill that can be relieved shall be removed."

## HOOKWORM AS A NEW HEALTH PROBLEM IN ST. CROIX

By T. H. HAYES, Lieutenant (Junior Grade), Medical Corps, United States Navy

The importation of labor into St. Croix is not a novel procedure. From the earliest days of cane cultivation the demand for labor has always exceeded the supply. This was true even before the emancipation of the slaves in 1848, and, after that time, so acute did the

situation become that the colonial council passed the importation act of 1873 providing for the part payment by the Government for the importation of laborers from the neighboring islands. After the passage of this act boatloads continued to come in over a period of several years. The type of immigrant received was of a low grade mentally and physically, if we are to accept the chronicles of that time—the state of health being much better among the women than the men—and, in spite of physical examinations before emigrating and on entrance to St. Croix, there is evidence at hand to indicate that much disease was brought in through imported labor. Leprosy, syphilis, tuberculosis, and schistosomiasis are among the diseases most probably imported in greatest numbers. All of them are conditions very easily missed in a perfunctory examination and often escaping notice in more thorough inspections.

It is not to be understood that St. Croix was entirely free from the conditions named before the importation of 1873, but, by the increase, dissemination became more rapid and widespread, and, as a result, much revenue has been expended and even to-day is being expended, to solve health problems which arose through this promiscuous importation of labor and the lack of appreciation of the great economic value of the conservation of the working power of the producing class by the close guarding of the public health.

Of course, we must realize that our knowledge of disease control has increased considerably since the era referred to above and the lack of appreciation mentioned must not be interpreted as synonymous with indifference.

For the past few years there has been a steady migration of the working classes from St. Croix to the United States. Progress continues to take from the fields many of the natives remaining in the island, to work as mechanics, clerks, and artisans of various kinds, and thus the population of towns increases and that of the squatter villages decreases. Closer observation will show that the town is but the intermediate step in many instances between the cane fields of St. Croix and the United States. Thus the labor situation has grown year by year more acute. The cry for labor to-day equals the planters' cry for rain on Santa Cruz.

Off to the north and west lies Porto Rico, with a population of 1,400,000 and with, in 1920, a density of population of 378.4 inhabitants to the square mile; more than ten times as great as the average for the United States. More than 90 per cent of the Porto Rican population depends upon agriculture for a livelihood. In view of the fact that Porto Ricans are not migratory by nature the question of overpopulation and sustenance is a serious one.

St. Croix and Porto Rico have gradually increased their interisland commerce, and from time to time in recent years Porto Rican mer-

chants, some interested in agriculture and cattle, have unostentatiously come into St. Croix on a small scale. In several instances they find themselves to-day well established in the island with material investments and stable enterprises which have every indication of permanency. The number of Porto Rican visitors to St. Croix gradually increased. Then came a few of the middle class, one by one, to take their place in the island as barbers, mechanics, servants, and so forth.

On October 25, 1926, a member of the colonial council from Frederiksted district who is interested in the greatest labor-employing concern on the island introduced what is known as bill No. 10, providing for the importation of labor from the British islands. This bill, had it been adopted, would have necessitated altering the immigration restrictions in force against the British islands at this time. The resolution was adopted by the council but disapproved by the governor. In his communication to this colonial council, Governor Trench made reference to the great amount of available labor in Porto Rico. Porto Ricans already established in St. Croix had brought in a few families as laborers, but it appears that the Bethlehem Sugar Co. was the first to open negotiations for labor from Porto Rico, and to that company the first real load was brought. Other estates watched the experiment with interest and soon a few began importation.

It was in December of 1926 that the first Porto Ricans were brought in as laborers to work the cane fields, but according to the records available in the dispatching secretary's office these early arrivals are not reported, for they came in as passengers and were not classified as immigrant labor.

According to the only records available at this time the following table gives the total immigration figures, with the date of arrival in St. Croix and the port of entry:

| Date | Immigrants | Port of entry |
|---|---|---|
| Apr. 15, 1927 | 39 | Frederiksted. |
| Do | 7 | Christiansted. |
| May 20, 1927 | 6 | Frederiksted. |
| May 30, 1927 | 29 | Do. |
| May 31, 1927 [1] | 50 | Christiansted. |
| June 13, 1927 | 19 | Frederiksted. |
| June 27, 1927 | 9 | Do. |
| July 11, 1927 | 80 | Do. |
| Since July 11, 1927 | 121 | Do. |

[1] Since this date, none have entered through Christiansted.

Therefore, according to official records, there should be 360 immigrant laborers on the island, distributed about the different estates and in the towns of Frederiksted and Christiansted, but these figures

are not entirely accurate, since those arriving otherwise than on actual labor cargo boats are not accounted for, while some of the laborers have returned to Porto Rico after a brief stay here. However, it is plainly evident to anyone familiar with the rural districts that the above figures are in error in showing too few. It is the general opinion that the number of Porto Rican laborers is between 400 and 600. It is common talk throughout the island that Bethlehem alone can use and wants at least a thousand.

When the first boatload arrived the medical department was aware of and concerned with the facts set forth below.

Porto Rico, relatively speaking, is not a healthy island, suffering, as it does, from those diseases dependent upon overcrowding, poverty, and agricultural pursuits. There, two great scourges, malaria and hookworm disease, both of which are extreme rarities in St. Croix, are prevalent. Uncinariasis is a debilitating disease and lowers the body resistance, making the individual susceptible to all other diseases. The urban zone of Porto Rico in 1926 presented from 45 to 85 per cent of infections; the rural zone showed 80 to 95 per cent infections; the graded schools showed 35 per cent infections. The *Nector americanus* is the common type of infection, although in 25 per cent of cases the *Ankylostoma duodenale* is found. While Brazil is considered a zone of very high infection, with an average of 130 worms per person, Porto Rico shows an average of 419 adult parasites per person.

Realizing the dangers of absolutely ignoring this immigration, the medical department, under great difficulties, attempted to locate the laborers on the different estates, and those found were brought in to the municipal hospital in Christiansted for stool examinations. The positive cases were treated and returned to their estates.

Among the chief difficulties soon met may be mentioned: First, the urgent need of some definite and accurate method of checking on the arrival of the Porto Ricans and their location and movements on the island. I have sought information in this regard for the past eight months and there is no department on the island able to offer any assistance. In many instances it is difficult to arouse the estate owners and employers to the necessity of having these examinations made early, and, because of their desire to get the field work completed, and the newcomers' urgent need of ready money, a passive resistance is built up, and field contamination may take place before the examinations can be made. Then again, the medical department, under the circumstances, has had to go slowly, in view of the fact that it realizes that it has acted in an emergency only, fully expecting that pertinent legislation would immediately develop to establish a policy in regard to this issue. This has prevented the department from being more drastic in its control measures, but, in the mean-

time, we have carried on as well as we could, putting forth every effort to minimize the dangers which we believe to exist, but being very careful to remain within our prerogatives at all times.

A brief review and summary of the situation as I have seen it for the past eight months follows.

When the laborers come to St. Croix from Porto Rico, so far as I can learn, the medical department receives no official notice. Of course, under the existing circumstances, such notice is not required nor deemed necessary. Once in St. Croix, they go to that part of the island in which they are to work, and change and rechange to different estates with no record kept as to their whereabouts.

Basing his search on hearsay as to where a crowd of Porto Ricans may be found, perhaps getting a clue as to the total in a shipload, the sanitation officer laboriously rounds up a few at a time, as he locates them, and brings them into the hospital in Christiansted for stool examination. As stated before, because of the great need of labor and the Porto Ricans' need for money at once, these examinations have lately been carried out on Saturdays only, in order to prevent time being lost from work. The department has felt that this is a procrastinating procedure and would prefer to be in a position to adopt more drastic measures for the ultimate good of all, but, sensing the situation and believing that a half step forward is better than marking time until a policy is adopted, such has been our attitude. Those found positive are treated at the earliest possible moment conducive to the continuance of the amicability of the employer, employee, and the medical department. The follow-up work, like our examination procedure, is not so well systematized as it should be to insure perfect results. The patients are hard to find, they are widely scattered over the island, and this field work must be sandwiched in between the routine daily duties of the doctor and the sanitation officer.

In the Frederiksted district, a nurse is sent out by ambulance and specimens are collected on the estates and brought in to the hospital for examination. This is not considered expedient in the Christiansted district at present, but it seems to work well in the west end.

Here in the Christiansted hospital, we have found that, despite many authors, a saline cathartic early in the morning gives a better stool for examination, and more positives are found in such than in the constipated stool.

The magnesium sulphate and glycerine technique has been found to be a great time-saving procedure and a more accurate method of stool examination than the plain saline emulsion.

Besides the positives found at the time of a routine examination, a few positives have been found in those Porto Ricans in the hos-

pital for other causes or because they show clinical evidence of their infestation.

Up to and including August 17, 1926, there have been made, in all, 122 examinations. Positives total 41, negatives total 81; a percentage of 33.6. As compared to figures for Porto Rico this does not present a serious percentage, but, when it is noted that, in 1925, out of a total of 712 examinations only 4 were positive for hookworm, and those 4 were the first 4 Porto Ricans brought into St. Croix for labor, then these figures take on a different aspect.

The treatment used to date in the Christiansted district is carbon tetrachloride given alone except for the accompanying salts. We have found it very satisfactory, although it is, no doubt, more efficacious when given with oil of chenopodium. The great advantage of giving the plain carbon tetrachloride is that it is quicker treatment and entails less loss of time from the fields. When the other more toxic drugs are used, I do not believe it safe to give treatment until the patient has had his period of starvation under our own observation, and that takes more time, at least another 24 hours. The West End uses thymol.

The uncinariasis bureau in Porto Rico gives the carbon tetrachloride with oil of chenopodium, and the subsequent treatment, if necessary, is by thymol.

We visit those villages where the Porto Ricans are living, talk with them, advise them on health measures, and encourage them to come to the hospital immediately on feeling badly. By this procedure we have found positives not found at the time of routine examination. Their general health is bettered, we gain their confidence, and an admirable cooperation is obtained. In one village of 14 Porto Rican families, when they first arrived fully two-thirds of them were sickly with one complaint or another. Within a short time I had had some member or members of every family in that village hospitalized and treated for their respective ailments, some of them having hookworm, and to-day that village is a healthy, active little community, and the estate owner is very much pleased with their work, whereas at first he was greatly discouraged because of their poor state of health. To-day those people seek the doctor's advice at the first sign of ill feeling. Under favorable circumstances and a little help, this can be accomplished in other villages.

A survey of the villages and living quarters and environment of these laborers readily shows the marked inadequacy of the estates at the present time to insure against the spread of hookworm disease. On many of the estates there is not one privy, latrine, or outhouse of any description, and the fields and the ground near-by the villages, in areas passed over all day by barefooted men, women, and children, afford the only defecating area. In one village recently surveyed

there was one privy large enough to accommodate one person at a time and the Porto Rican population of that village alone was about 60, not to mention almost as many native Crucians. The privy had not been in use for at least several years, was in an advanced state of dilapidation, and weeds were growing so thick and high as to prevent the door from opening. There was no evidence of a beaten path common to regularly frequented sites. On the ground, however, about the village human feces was noted in great quantities and throughout the village was a persistent odor of human excrement.

The sanitation department is extending every effort to correct these conditions. Most of the property owners, when talked to on the subject, appear cooperative and seem to appreciate that this care of the individual laborer and protective measures for the preservation of the general health are essential, and, in most instances, agree to correct these glaring deficiencies which are incompatible with good health. They do make *some* effort and then cease until urged again. This passive resistance and indifference is partly due to the inability, in some cases, for the man to see the value of his interest in such things in terms of dollars and cents. In other cases it is plain ignorance which refuses to be advised and convinced that these are matters of importance; a case of ignoring what they can not understand.

In other quarters the contention is raised that the soil and climatic conditions here are not conducive to the growth and development of the hookworm. It must be remembered that when the Crucian refers to St. Croix's aridity, he speaks in terms of cane raising only. A perusal of the weekly crop and weather bulletins over different areas of Porto Rico during 1927 shows the precipitation as reported from Viequez, the area from which the great majority of these laborers are coming, to total only 18.66 inches, while the precipitation in St. Croix over that period, as taken at the experiment station here, is given as 29.48 inches.

It is true that great downfalls are not experienced in St. Croix every week, but throughout the island there is very frequently a moderate precipitation, which is really of no consequence from the standpoint of cane growing, but which for the furtherance of hookworm is of great importance. The figure given above (29.48), of course, represents the register from the experiment station only. In many localities they have had much more rain, while in other areas there has been a little less, but it is safe to conclude that where the best rainfall is there one is most likely to find greater labor activity.

The evaporation rate is greater here in St. Croix than in Porto Rico as a whole, but even in those areas of greatest evaporation rates in Porto Rico and in those soils giving up their water by rapid drain-

age, the hookworm grows. Relatively speaking, the organism is not fastidious and the persistence of the hookworm through long droughts in the southern United States is an exhibition of some degree of the power of adaptability inherent in the worm. One must not forget that, with the great number of worms carried in the intestinal tract of these people (averaging 419 worms per person), and a female capable of expelling 9,000 ova daily, and the adult able to survive in the intestinal tract for 10 years, the worm has a great offensive and defensive power for the preservation of its species through almost any drought. Comparisons of the soil remove any doubt as to soil suitability for hookworm growth on St. Croix. In general, throughout the island of St. Croix, the soil may be described as a sandy loam which grades off into a gravel. Soil of such a consistency is extremely porous, which is ideal for the development of the hookworm. Of course, there are scattered areas here and there where the soil contains more clay, but not to the extent found in Porto Rico. The Adjuntas clay soil covers an area equivalent to 14.2 per cent of the Porto Rican soil, exceeded only by the Tanama stony loam, which constitutes 19.7 per cent. Heavy clay soils are not porous but are quite coherent and tight, and such soils are not so favorable for hookworm growth as those of the porous type. Reference to the soil structures may be found in Bulletin No. 3 of the Porto Rican Agricultural Experiment Station, "Soil survey from Arecibo to Ponce, P. R.," by Clarence W. Dorsey, Louis Mesmer, and Thomas A. Caine, and in Bulletin No. 2, St. Croix Agricultural Experimental Station, "Sugar cane in St. Croix," by Longfield Smith.

I have never heard the temperature offered as a protective factor in St. Croix. It is agreed that it is warm enough for the growth and development of the organism.

Field observation further reveals that while the families may live on one estate, in some instances they walk or drive miles to work on another estate all day and return to their village in the evening. This means that some estates, although not credited with having Porto Ricans attached to them, must, nevertheless, provide some means to prevent contamination of soil where these men work, for it is self-evident that no man is going to return to a well-constructed, adequate privy provided him in his village of "X" if he is working 9 miles away on estate "Y."

Something must be said in regard to the Porto Rican himself. To me he has been the one bright spot in the situation. Whatever we have been able to accomplish in the way of lessening the danger of hookworm dissemination throughout the island is largely due to the Porto Rican laborer himself. He has been cooperative to the full extent of his ability. He has shown himself willing and anxious to help himself, and in our relations with him in this work not one

unpleasant incident has arisen. It is true that the great majority of them are illiterates and therefore have a highly developed protective reflex, which is common to such people. This manifests itself at first by a hesitancy to comply at once with any measure not presented to them in terms which they can fully understand. This psychological negativism should not be confounded with belligerency. Experience with these people has proved this. It must also be remembered that it is exceptional to find any of them, except a few of the children, who speak any English whatsoever. In the face of this difficulty they are carrying on admirably.

When the Porto Ricans first arrived, I heard many of the planters objecting to their demands for better quarters in which to house their families. The quarters assigned to them in most instances are the stone houses of the squatter villages, formerly used by the Crucian squatters. Some of them had not been in use for a long time; others were in a bad state of repair, and the general environment was squalid and unfit for habitation. The planters were of the opinion that if they were good enough for the other laborers they must be good enough for the Porto Rican. The planter is gradually learning that the laborer is an individual with home life as a part of his scheme of things. He has a legal wife and family to support, and his deportment speaks of a permanency not found among the Crucian labor. Through his children or his relatives' children, who have attended the schools of Porto Rico, he has come to know about hookworm, the danger of uncontrolled fly breeding, mosquito-borne diseases, and the like. He associates filth with disease and poor health. It is the Porto Rican himself who, in many instances, insists to the estate manager that latrines should be built, stables moved from the vicinity of the living quarters, and the tall weeds cut for health reasons. He keeps his house clean, and entire families may be seen clearing away the accumulation of Crucian dirt and débris that has characterized these villages for years. New floors and ceilings are being put in as fast as the owners can be persuaded to do so, and a Porto Rican village can be located easily by the amount of new clean paint.

Recently, in passing through a village where both Porto Ricans and Crucians lived, it was striking how free the Porto Rican houses were from flies and how abundant they were in the Crucian homes.

From the foregoing, the following conclusions are drawn:

1. Owing to the high potentiality of hookworm disease in the country from which the laborers are imported, the percentage of positives found to date by our examinations, the soil and climatic conditions being favorable, and the estates unprepared for properly preventing the spread of hookworm disease, there has certainly been created a new health problem of great importance to Saint Croix.

2. Our present activity is not sufficient to obliterate the menace. Greater cooperation and authority are needed.

The suggestions which follow are made in the hope that they may aid in solving the problem.

Two projects must be carried out to combat successfully the situation. The infested individual must be rid of his parasites and the prevention of soil contamination to eliminate subsequent infection after treatment must be accomplished.

To accomplish the first, it is absolutely necessary that the medical department be systematically kept in touch with the arrival and location of the immigrants. This guarantees the instant examination and early treatment of the positive cases. If instructions from an authoritative source could be issued to all estate owners requiring them to submit a list stating number, name, and location of all Porto Rican laborers in their employ to date, and in the future to report, at some specified interval, any changes in their Porto Rican census, we could handle the situation with some degree of celerity.

The uncinariasis bureau of Porto Rico has found that for the small sum of $1.17 the individual can be quickly cured, restored to normal life, and made useful to society. This is a small sum compared with what it will cost to hospitalize these cases later for the many and various diseases to which hookworm renders the infested individual liable through lowered resistance. It is also cheaper than sterilizing infected zones, once soil contamination has taken place. Moreover, if this phase of the work is expedited, fewer cases of hookworm will be seen among the Crucians, and it is beyond reasonable doubt that once the Crucian laborer is infected problems will multiply and expense will mount. For, with the Porto Rican we are dealing with an individual who in most instances is an illiterate but is intellectually able to accept and use training and instruction. In many cases he has had the advantage of health propaganda in Porto Rico and appreciates these health measures. But the Crucian is mentally defective in many cases, and, to a great extent, is unable to realize the importance of following instructions and can not be depended upon for cooperation. Superstition, a bliss-creating ignorance, and a moronic state form a triad hard to overcome.

To complete the second project, immediate facilities must be provided to obviate the necessity of contaminating the soil by promiscuous defecation on the ground. The erection of adequate privy space is essential for the control of the situation. To do this, the cooperation of the planters and estate owners is necessary. They must be educated to the point of realizing that a laborer in an anemic state, such as is produced by hookworm, is physically unfit to lead a normal life and can not give his employer a fair return for

his wages. They must have it pointed out to them that while the laborer does benefit by these measures, it is really the planter or owner who reaps the greater return in dollars and cents.

A few talks to planters and owners on hookworm by the chief municipal physician may do much to smooth out the difficulties, when the situation is put up to them in terms of dollars and cents and the small outlay necessary to provide privies and clean villages is pictured as an investment. The actual building of privies, and so forth, is not enough. It is a sincere and cooperative attitude, with his spirit in the thing, that we should bring out in the employer, if possible. The idea that he is *responsible* for the proper disposal of excrement in his villages should be converted into a *desire* for proper disposal of excrement in his villages. This changes the status of the sanitary officer from that of a policeman into that of an advisor.

For those who are incapable of taking in the truths brought to them in educational talks by one specially trained and capable of advising them to their advantage, and to safeguard the health and prosperity of the remaining public, the health regulations covering the points violated should be rigidly enforced, and where such regulations do not exist, legislative action would not be amiss.

One can not be so idealistic as not to expect some resistance in some cases, for that seems to be a characteristic of all attempts to better an uninformed public, and some parts of all publics are incapable of receiving information.

In 1765, Don Alejandro O'Reilly, an Irish nobleman in the service of King Charles III of Spain, on arriving in Porto Rico, reported the Porto Ricans as being lazy and unwilling to work. Andre Pier Landru, in 1810, gave them a similar reputation. Col. George B. Flintner, in 1834, likewise described them, and to-day, in those areas where the hookworm work has not been carried out, the health department will report the inhabitants as lazy and indifferent to work and life in general. But in the controlled areas they were willing workers with pride and self-respect.

Unless the employers are educated in these things, they, too, will come to see them as a lazy, indifferent set, and then, losing confidence in them as a people, may cast aside a valuable source of labor, and with their Crucians already infected with hookworm, their labor situation will be even more acute.

We must be fair to the laborer, and exert our efforts to keep him fit to earn enough to support himself and family. We must be fair to the employer, and do all we can to prevent him from judging a hookworm-infested laborer as he was judged in 1765, 1810, and 1834. We must guarantee the employer, as well as we can, a fair return for wages paid. We must be fair to ourselves, and not permit a repeti-

tion of 1873; for now, unlike then, we can not justify ourselves in time to come with the alibi of ignorance.

The medical department, at a very small expense, can give to St. Croix a healthy, capable labor from Porto Rico if the whole-hearted cooperation asked for is granted early, but the ultimate cost to the municipality and to the employer must be directly proportional to the delay in offering this support.

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## DENTAL OBSERVATIONS ON THE ANNUAL PHYSICAL EXAMINATION

By L. C. Frost, Lieutenant Commander, Dental Corps, United States Navy

Annual physical examinations of naval and marine officers have been conducted by the Navy Department for many years, and all officers on active duty are required to undergo them. The importance of a thorough annual physical examination was not appreciated by many until and within the past decade, but with the rapid strides being made in the science of preventive medicine the endeavor to detect disease in its incipiency and to institute corrective measures has given a new importance to the annual physical examination or, as it has been designated, " the annual health examination."

This annual health examination has always included an examination of the oral cavity, in which particular portion of the examination, whenever practicable, naval dental officers have been assigned to duty as members of the examining board. The dental examination which is conducted as a part of the annual health examination is as comprehensive and thorough as the facilities will permit. However, due to the fact that naval dental officers have not always been available as members of the examining boards, the dental examination has not been uniformly so thorough as is desirable, and, so far as the writer knows, no detailed statistics have been preserved on this portion of the examination similar to the detailed reports of other physical conditions found.

The first of this year (1927) the writer was assigned to duty as a member of the annual health examination board at the Naval Dispensary, Navy Department, Washington, D. C. The examination of this board was conducted in the months of January and February, during which time careful examination was made of the mouths and teeth of approximately 500 naval and marine officers. In this examination there was prepared a detailed chart of the oral cavity, and a record was kept, not only of the condition of the teeth, but of other physical conditions ordinarily related thereto, and there has been compiled from these records a report of the conditions found.

It is realized that observations made in connection with the examination of a relatively small group can not be applied generally. However, the group of officers which was examined may be considered

representative of any similar group throughout the service. It included officers ranging in age from 24 to 64 years, who were serving or had served under virtually all conditions encountered in the naval service. Indeed, the group included individuals serving or who had served under varied climatic conditions, such as those encountered by aviators, submarine officers, officers on cruising surface vessels, and officers on shore duty, which enhances the value of the statistics gathered for the purpose of study. In making this examination and in keeping the statistics the writer had in mind the observations of Kerr [1] who, in his report on the 1924 examination, stated that the examination should determine the condition of every tooth present in the mouth. "Each tooth should be tested for vitality, and special attention should be directed toward teeth which are restored by large fillings or inlays, those carrying crowns of any description, and teeth used in the abutments of bridges or as supports for other appliances." Kerr further expresses the opinion that dental infections are of first importance among the acute or chronic infections which are concerned in the etiology of albuminuria, but he invites attention to the strange fact that only 19 officers were reported as having defective teeth during the annual physical examination conducted in 1924.

Without appearing to criticize in any way, it is obvious that the dental examination referred to was not comprehensive or satisfactory, and that the finding, rather than being of defective teeth, was a finding as to unsatisfactory dental conditions. Such findings, according to the writer's belief, are too general to be of any value for a study of any sort, particularly with relation to the general health reports. As a result of what appears to have been a superficial dental examination in connection with the 1924 annual health examination, assignment has been made of dental officers to duty as members of all annual physical examination boards wherever practicable.

TABLE 1.—*Schedule of dental statistics*

DATA BASED UPON GRAND TOTAL TEETH EXAMINED (15,424)

| | | | |
|---|---|---|---|
| Fillings: | | Dentures: | |
| Gold | 1, 428 | Partial upper | 31 |
| Amalgam | 5, 174 | Partial lower | 32 |
| Synthetic | 783 | Full upper | 14 |
| Cement | 32 | Full lower | 9 |
| Crowns: | | Missing teeth: | |
| Gold | 350 | Upper | 1, 032 |
| Porcelain | 125 | Lower | 929 |
| Bridges: | | | |
| Removable | 13 | | |
| Fixed | 126 | | |

[1] Kerr, W. M.: The annual physical examination, United States Naval Medical Bulletin, vol. 21, No. 3.

DATA BASED UPON TOTAL NUMBER OF CASES EXAMINED (482)

| | Cases |
|---|---|
| Nonvital teeth | 218 |
| Use of tobacco (smoking): | |
| Excessive | 33 |
| Moderate | 384 |
| None | 65 |
| Membranous lining: | |
| Inflamed | 82 |
| Normal | 400 |
| Pyorrhea | 67 |
| Gingivitis | 76 |
| Vincent's infection | 12 |
| Leucoplakia | 3 |
| Salivary calculus | 375 |
| Green stain | 3 |
| Erosion | 98 |
| Recession | 181 |
| Care of teeth: | |
| Good | 289 |
| Moderate | 143 |
| Poor | 50 |
| Dental condition: | |
| Satisfactory | 266 |
| Treatment needed— | |
| Urgent | 25 |
| Early | 171 |
| Prosthetic | 20 |

In the examination a record was kept of the oral condition of 482 officers (Table 1). It shows the following items:

Fillings of various kinds and materials.

Crowns—porcelain and gold.

Artificial dentures.

Bridges—removable and fixed.

Plates—partial and complete.

Sound, nonvital, carious, filled, and missing teeth.

Accretions of salivary calculus.

Green stain.

Paradontic diseases.

General condition of membraneous lining of oral cavity.

A careful record of the officers as to the use of tobacco was also made, as well as the care which the officers exercised in oral hygiene, and the general classification was made as to the need of dental treatment. These statistics have, in a large part, been graphically set forth in a series of charts which will demonstrate at a glance the general conditions found, and facilitate a study of the statistics.

Figure 1 is a composite dental abstract chart which shows the bilateral symmetry of the sound, carious and filled, and missing teeth. This bilateral symmetry has been a matter of observation in the dental profession for years; however, the exactness of the symmetry indicated in these charts is astonishing. This phenomenon can not be considered a coincidence, because of the large number of cases embraced in the examination. This chart also shows the proportion of sound, filled and carious, and missing teeth, both individually and collectively.

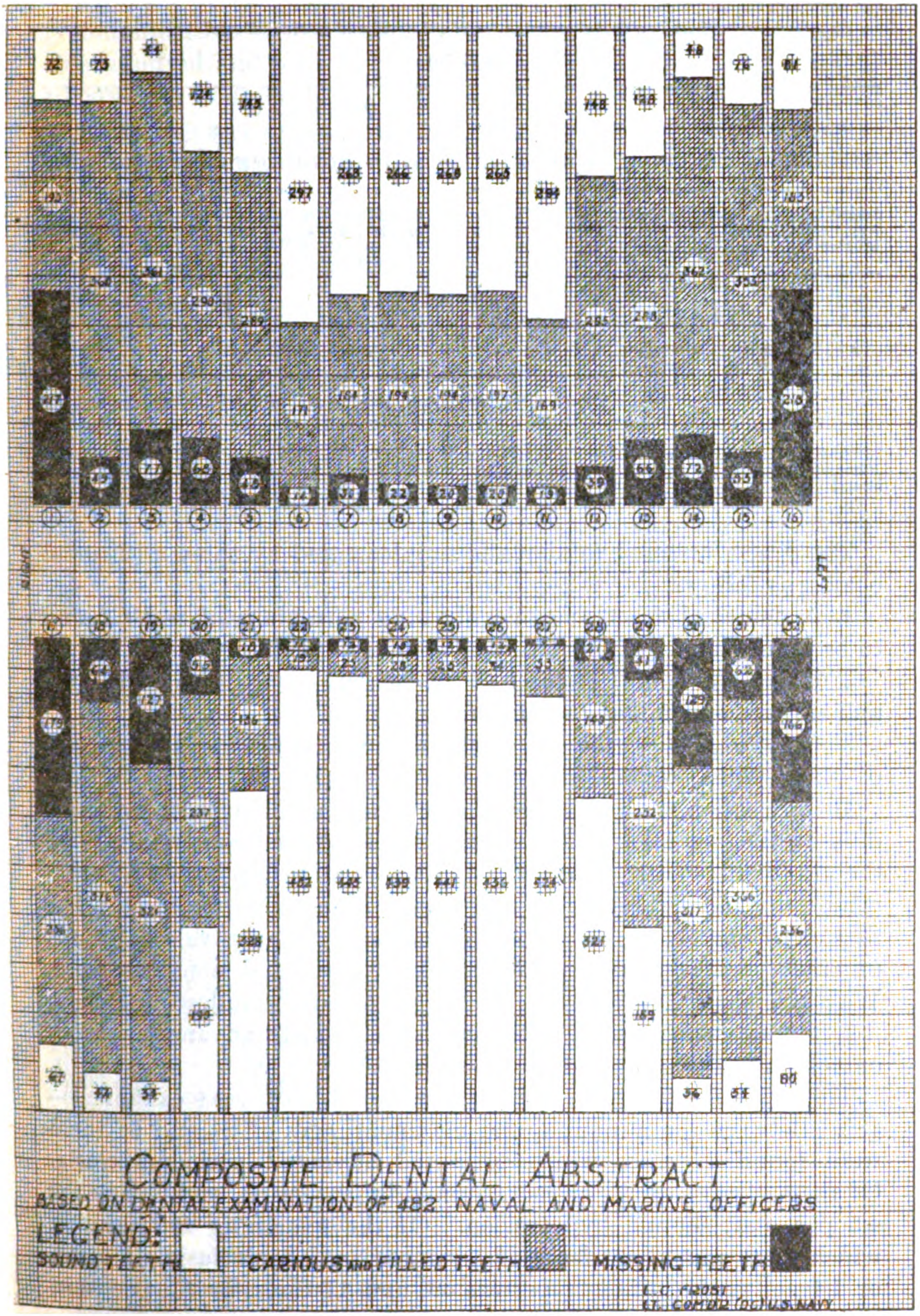


Fig. 1.—Composite dental abstract

TABLE 2.—*Dental abstract schedule—Percentage of the several teeth found to be sound, filled and carious, and missing*

[Based on dental examination of 482 naval and marine officers]

UPPER

| | Tooth No. — | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
| Sound..................per cent.. | 15 | 15 | 9 | 26 | 30 | 62 | 56 | 55 | 56 | 55 | 61 | 30 | 26 | 10 | 16 | 17 |
| Filled and carious..........do.... | 40 | 75 | 75 | 60 | 60 | 35 | 38 | 40 | 40 | 41 | 35 | 62 | 60 | 75 | 73 | 38 |
| Missing..................do.... | 45 | 10 | 16 | 14 | 10 | 3 | 6 | 5 | 4 | 4 | 4 | 8 | 14 | 15 | 11 | 45 |

LOWER

| | Tooth No. — | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (17) | (18) | (19) | (20) | (21) | (22) | (23) | (24) | (25) | (26) | (27) | (28) | (29) | (30) | (31) | (32) |
| Missing..................per cent.. | 37 | 13 | 26 | 11 | 4 | 2 | 2 | 3 | 2 | 2 | 1 | 4 | 9 | 27 | 13 | 34 |
| Filled and carious..........do.... | 49 | 78 | 67 | 50 | 28 | 4 | 6 | 6 | 6 | 8 | 11 | 30 | 52 | 66 | 76 | 49 |
| Sound..................do.... | 14 | 9 | 7 | 39 | 68 | 94 | 92 | 91 | 92 | 90 | 88 | 66 | 39 | 7 | 11 | 17 |

The graph referred to above is supplemented by three additional charts, as follows:

1. A dental abstract schedule, showing percentage of teeth found to be sound, filled and carious, and missing. (Table 2.)

2. Composite dental abstract of the various groups of sound, filled and carious, and missing teeth. (Fig. 2.)

3. Comparative ratios (percentage) in progressive age groups of sound, filled, carious, and missing teeth. (Fig. 3.)

In connection with this dental examination there were available data on the general physical defects of the officers examined. With the aid of these data, charts showing the relationship between dental conditions and hypertension and hypotension were prepared. The first chart (fig. 4) shows percentage ratios in progressive age groups of cases presenting advanced periodontoclasia and nonvital teeth. With this chart as a basis, the writer prepared the following charts:

1. Hypertension and hypotension in relation to advanced periodontoclasia in cases aged 24 to 64. (Fig. 5.)

The basis of this chart was the total number of cases examined—482. Between the minimum and maximum ages of 24 and 64 there were found 67 cases which presented advanced periodontoclasia. Of these, 6 cases, or 9 per cent, showed hypertension, and 3 cases, or 4.5 per cent, showed hypotension. Of the remaining 415 cases in which there was no evidence of advanced periodontoclasia, 18 cases, or 4.4 per cent, showed hypertension, and 17 cases, or 4.1 per cent, hypotension.

The lower section of this chart refers to the cases between the ages of 49 and 64.

In this chart ages 49 to 64 were used for the reason that 49 years was the age of the youngest officer examined who presented advanced periodontoclasia in connection with hypertension and hypotension. One hundred and nine cases were examined, of which 26 presented advanced periodontoclasia. Of these, 6 cases, or 23.1 per cent, showed hypertension and 1 case, or 3.8 per cent, hypotension. Of the remaining 83 cases in which there was no evidence of advanced periodonto-

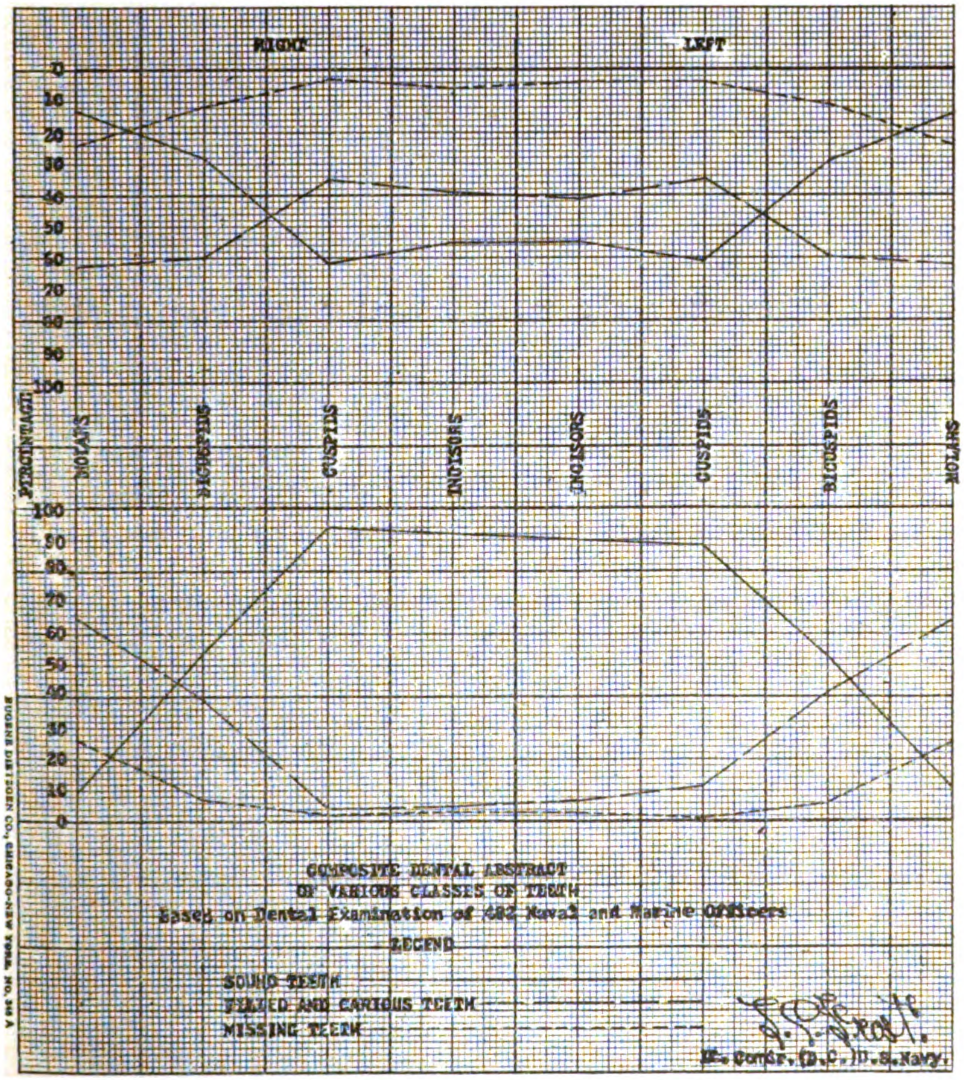


Fig. 2.—Composite dental abstract of various classes of teeth

clasia, 10 cases, or 12 per cent, had hypertension and 3 cases, or 3.6 per cent, had hypotension.

2. Charts showing the relation of hypertension and hypotension to nonvital teeth. (Fig. 6.) The upper section includes all ages.

Four hundred and eighty-two persons were examined, of whom 218 presented one or more nonvital teeth. Of these, 11 cases, or 5.1 per cent, showed hypertension, and 10 cases, or 4.5 per cent, hypotension.

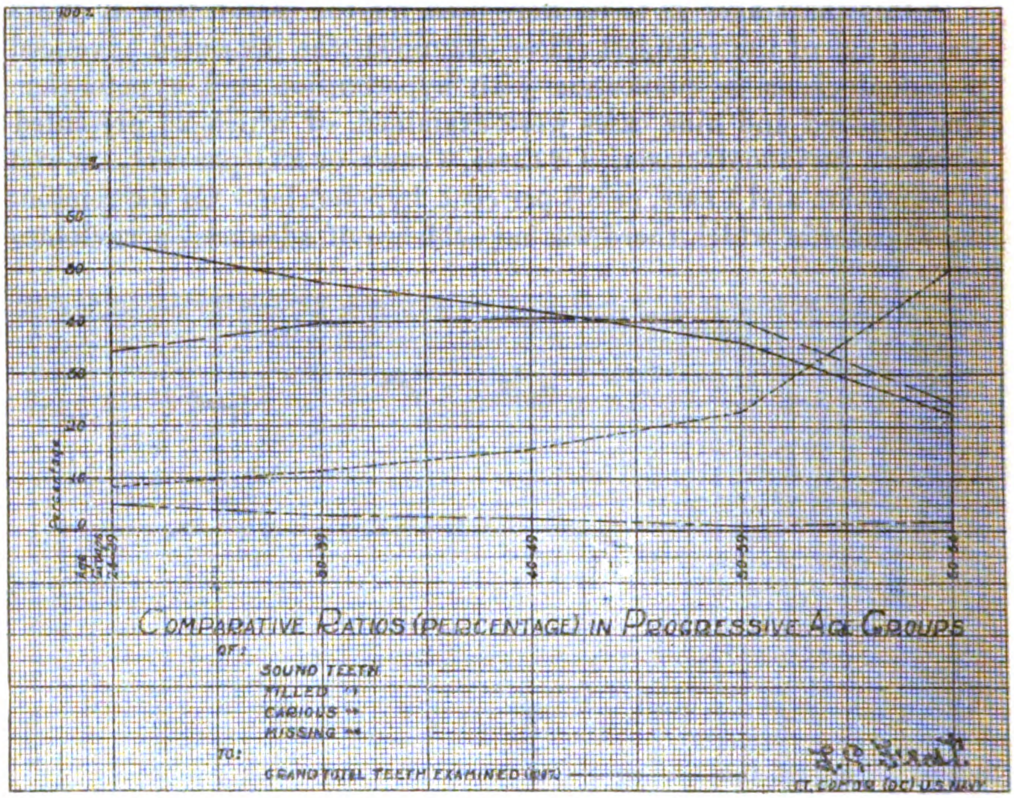


FIG. 3.—Comparative ratios in progressive age groups of various classes of teeth

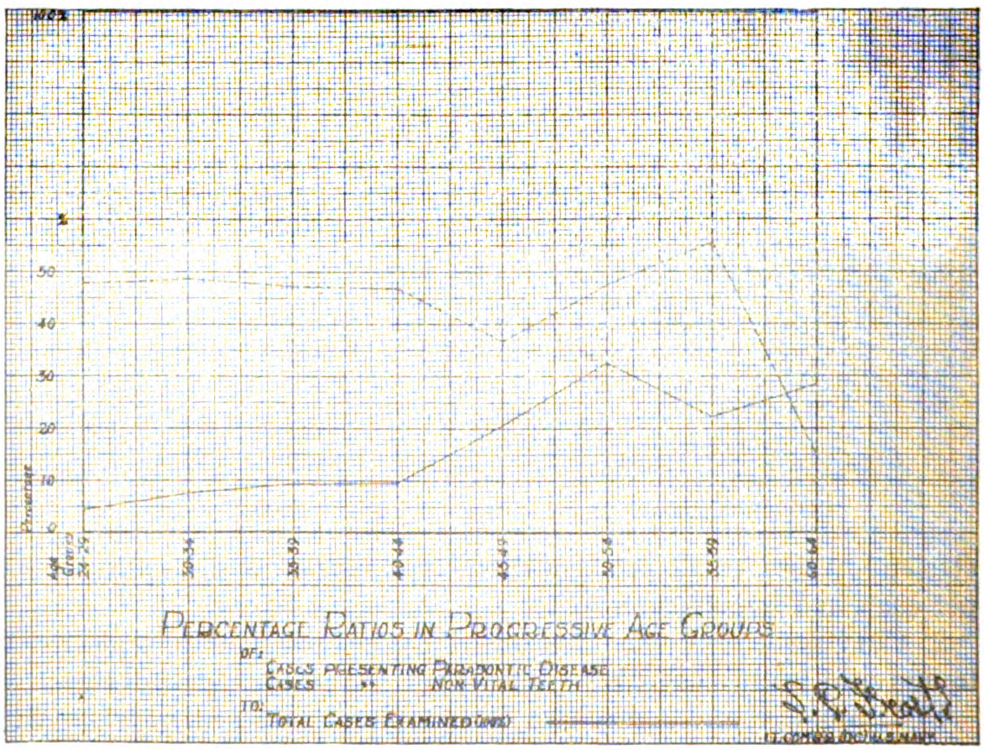


FIG. 4.—Percentage ratios in progressive age groups of cases with paradontic disease and nonvital teeth

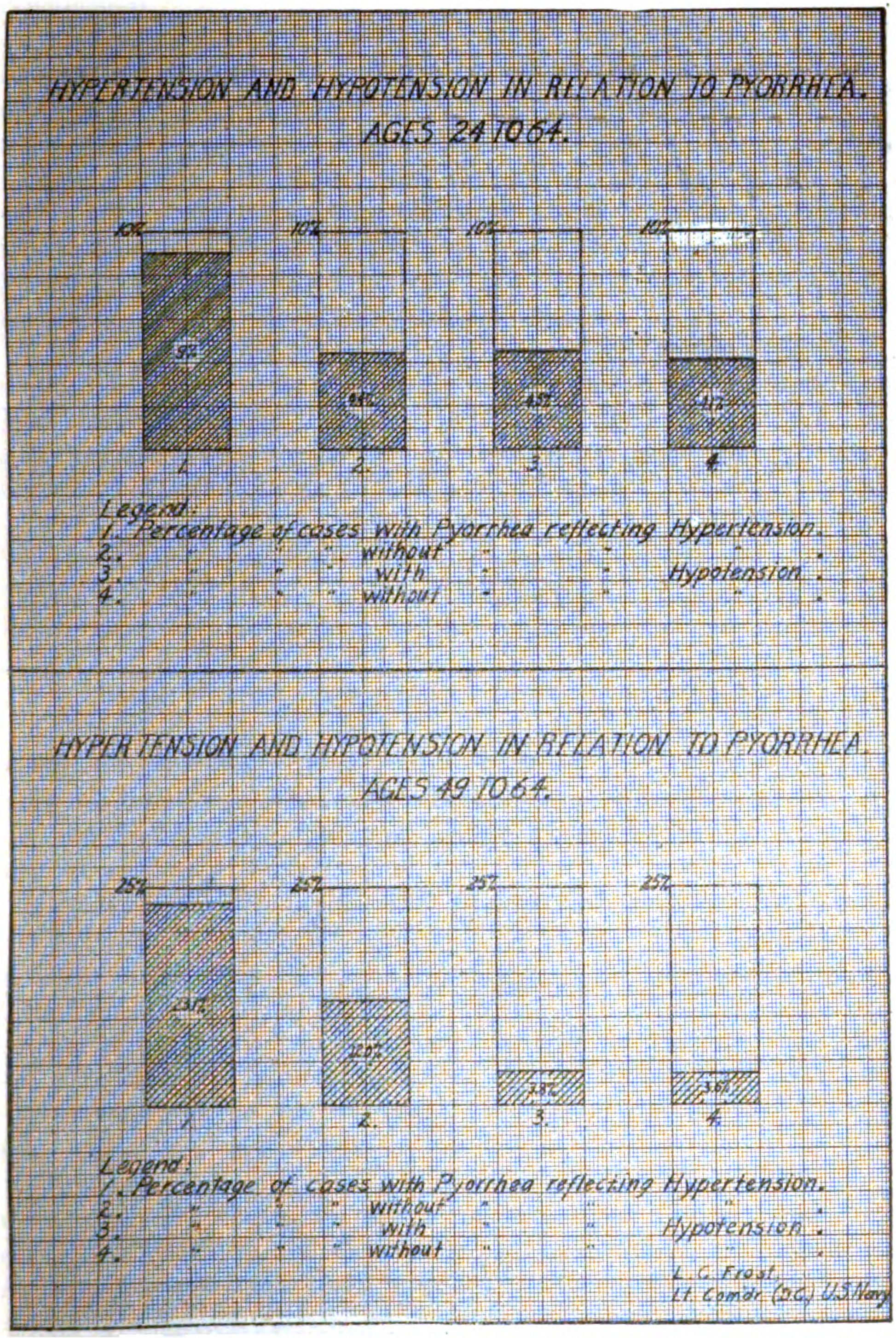


FIG. 5.—Hypertension and hypotension in relation to pyorrhea, by age groups

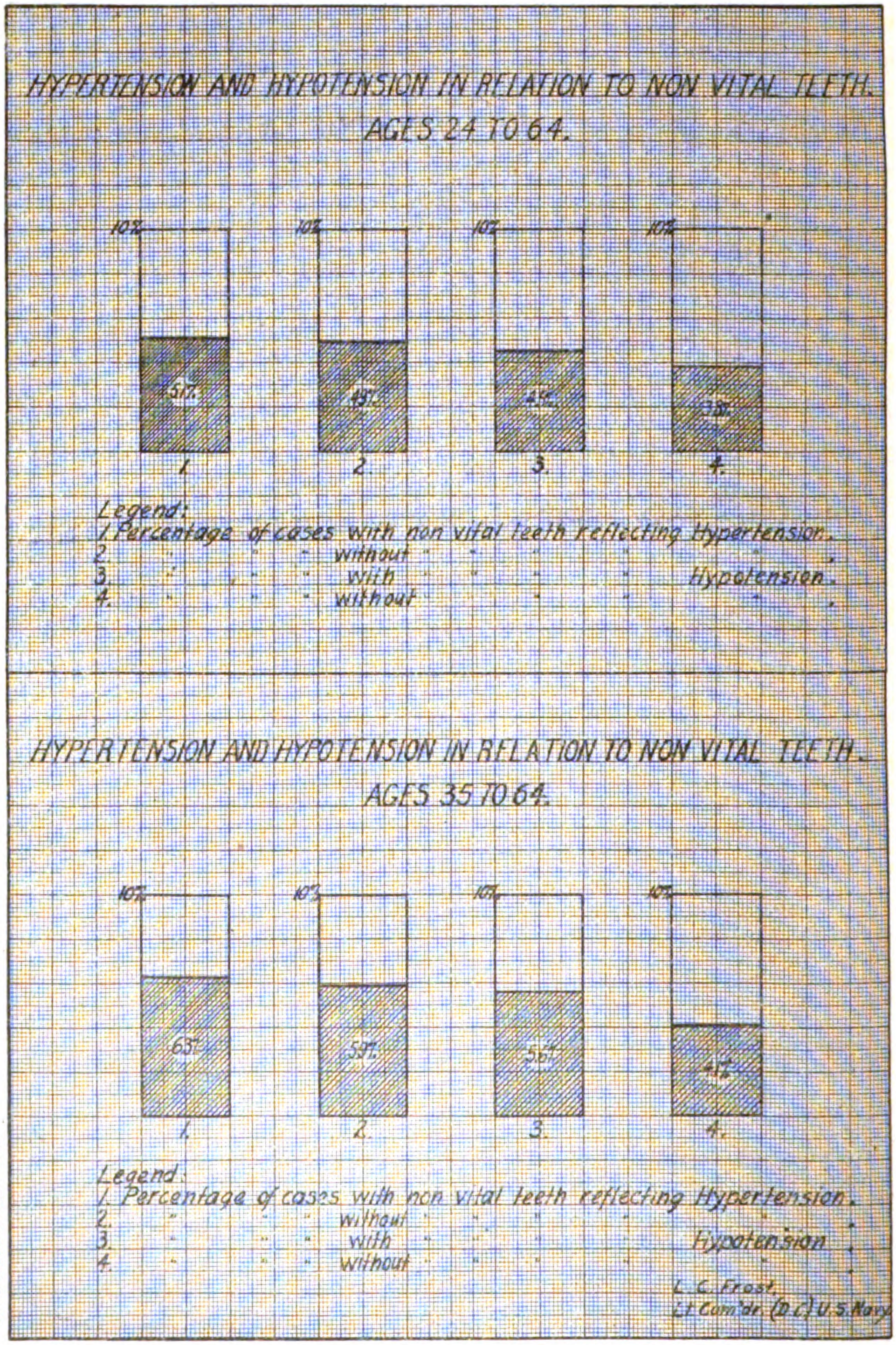


Fig. 6.—Hypertension and hypotension in relation to nonvital teeth, by age groups

Of the remaining 264 officers, in whom all teeth were vital, 13 cases, or 4.9 per cent, showed hypertension and 10 cases, or 3.8 per cent, hypotension.

The lower section of this chart includes ages from 35 to 64, for the reason that 35 years was the age of the youngest officer found with one or more nonvital teeth in connection with hypertension and hypotension.

In this group, 393 officers were examined, 175 of whom presented one or more nonvital teeth. Of these, 11, or 6.3 per cent, showed hypertension and 10, or 5.6 per cent, hypotension. Of the remaining 218 officers, in whom all teeth were vital, 13, or 5.9 per cent, exhibited hypertension and 9, or 4.1 per cent, hypotension.

With reference to the nonvital teeth, such teeth as showed possible presence of infection were carefully examined. In a great number of these the writer found infected areas. Data, however, were not kept to indicate the exact condition of all nonvital teeth, all such teeth being considered as a possible source of infection.

The additional data which follow were compiled from medical reports of the annual health examination of these 482 cases.

*Hypertension.*—Of the 24 cases of hypertension reported in officers between the ages of 35 and 64, the following oral conditions were noted: One had chronic tonsillitis (teeth and mouth in good condition); 6 had pyorrhea, together with 1 or more nonvital teeth; 3 had 1 or more carious teeth without any abscessed or nonvital teeth, and no apparent evidence of paradontic disease; 11 cases had 1 or more nonvital teeth without any noticeable paradontic disease; while 1 officer with all teeth missing and 2 officers in whom no oral pathology was found showed hypertension.

*Hypotension.*—Twenty cases of hypotension were reported in officers between the ages of 33 and 57. Of these, 1 had chronic tonsillitis, teeth and mouth otherwise healthy; 3 had pyorrhea, together with 1 or more nonvital and carious teeth; 10 had 1 or more nonvital and carious teeth and no evidence of paradontic disease; and 3 cases had 1 or more carious teeth without any paradontic disease or nonvital teeth. There were 3 cases in officers who showed no oral pathology.

*Heart lesions.*—Two cases of cardiac arrhythmia—extra systole—were reported: One presented 4 missing teeth (mouth and teeth otherwise healthy); the other had all teeth missing. One case of mitral stenosis; several teeth missing, no other dental defect.

*Albuminuria.*—Four cases were reported, in 3 of which the patients had several nonvital, carious, and missing teeth; 1 of them had pyorrhea, and the other 2 presented no evidence of paradontic disease. The remaining case had 5 teeth missing, with no other evidence of dental disease.

*Error of refraction.*—Of 19 cases reported, in whom the error remained unchanged by the use of glasses, 4 had pyorrhea, 1 or more nonvital, missing, and carious teeth; 3 were found to have 1 or more nonvital, missing, and carious teeth, without any evidence of paradontic disease; 12 had healthy mouths; 2 had all teeth missing.

Of the 72 cases reported, in whom the error was corrected by the use of glasses, 22 presented pyorrhea, together with 1 or more nonvital, carious, and missing teeth; 17 were found to have 1 or more nonvital, carious, and missing teeth, without any noticeable evidence of paradontic disease; 5 had 1 or more carious and missing teeth, but no nonvital teeth nor paradontic disease; 3 had all teeth missing, while the remaining 47 presented healthy mouths. The errors of refraction occurred between the ages of 28 and 64.

*Deafness.*—In the 56 cases of bilateral and unilateral deafness reported, the following dental conditions were noted; 15 had pyorrhea, together with 1 to 10 nonvital, carious, and missing teeth; 9 had 1 or more nonvital, carious, and missing teeth with no apparent paradontic disease; 4 presented mouths with 1 or more carious and missing teeth only, while the remaining 28 were found to have healthy mouths—1 of these had all teeth missing.

These data are presented for such use as may be made of them in connection with health reports, with the thought that it will be desired in the future that such data or similar statistics may be uniformly kept by all examining boards and collected for study. While such data for a single examination may not be of very great value, it is believed that comprehensive statistics of this sort kept uniformly by the boards for a period of years will be of value in showing the exact relationship between dental lesions and systemic defects.

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## THE PINEAL SHADOW—A DIAGNOSTIC LANDMARK

By O. B. Spalding, Lieutenant, Medical Corps, United States Navy

The Röntgenologist in the course of a routine sinus examination has the opportunity to study both anterior-posterior and lateral views of the skull. The frequency with which the pineal gland can be visualized as the result of calcareous deposits, regardless of age or sex, must of necessity impress the observer; therefore, any apparent deviation of the pineal shadow from its relative normal position would readily attract attention and further inquiry. Antero-posterior or vertical displacement might escape the observer's attention, but any lateral deviation from the vertical plane, observed in the study of a true antero-posterior or postero-anterior projection of the skull would easily be recognized.

We are indebted to the work of Vastine and Kinney (1) for our knowledge of the normal average range of position of the gland in the antero-posterior and vertical planes.

They report, in reviewing skull films of 616 cases: "We have found sufficient calcification to visualize the pineal gland in the following percentages:

| Age (in years) | Number of cases | Percentage of pineal glands visualized |
|---|---|---|
| Below 10 | 9 | 0 |
| 10-20: | | |
| Female | 32 | 18 |
| Male | 42 | 19 |
| 20-30: | | |
| Female | 63 | 39 |
| Male | 58 | 56 |
| 30-40: | | |
| Female | 58 | 44 |
| Male | 67 | 67 |
| 40-50: | | |
| Female | 65 | 57 |
| Male | 88 | 63 |
| 50-60: | | |
| Female | 40 | 52 |
| Male | 53 | 60 |
| 60 plus: | | |
| Female | 16 | 68 |
| Male | 25 | 80 |
| Total | 616 | |
| Average | | 47.9 |
| Percentage over the age of 20 years in which pineal gland was visualized | | 59.2 |
| Percentage of females in which pineal gland was visualized | | 46 |
| Percentage of males in which pineal gland was visualized | | 58 |

Schuller (2), in 1919, suggested the value of the displacement of the pineal shadow in diagnosing intracranial lesions and cited one case of lateral displacement.

Naffziger (3), in 1925, cited several more cases in which the pineal gland had been displaced laterally.

Vastine and Kinney (1), in the course of their investigations, in order to estimate the value not only of lateral displacement, but also of antero-posterior and vertical displacement, as an aid in diagnosis, endeavored to establish a normal variation in the position of the pineal gland. They examined a series of approximately 350 skull films essentially negative for intracranial lesions, 200 of which showed calcification of the pineal gland. Measurements were taken as shown in Figure 1 from the pineal gland to:

(1) The inner table of the frontal bone at its most distant point.

(2) The inner table of the occipital at its most distant point.

(3) The inner table of the vault.

(4) The level of the base of the skull.

The accompanying charts illustrate their method of localizing pineal glands of normal skulls, which were found to lie between the

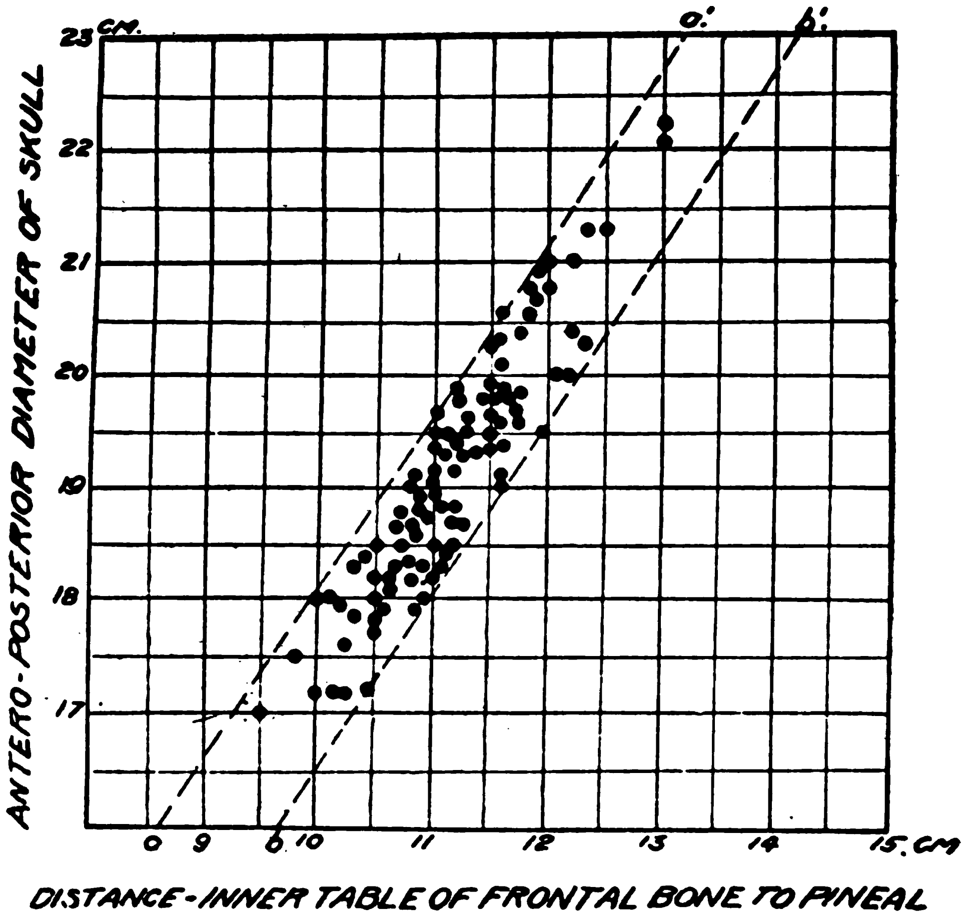


CHART 1

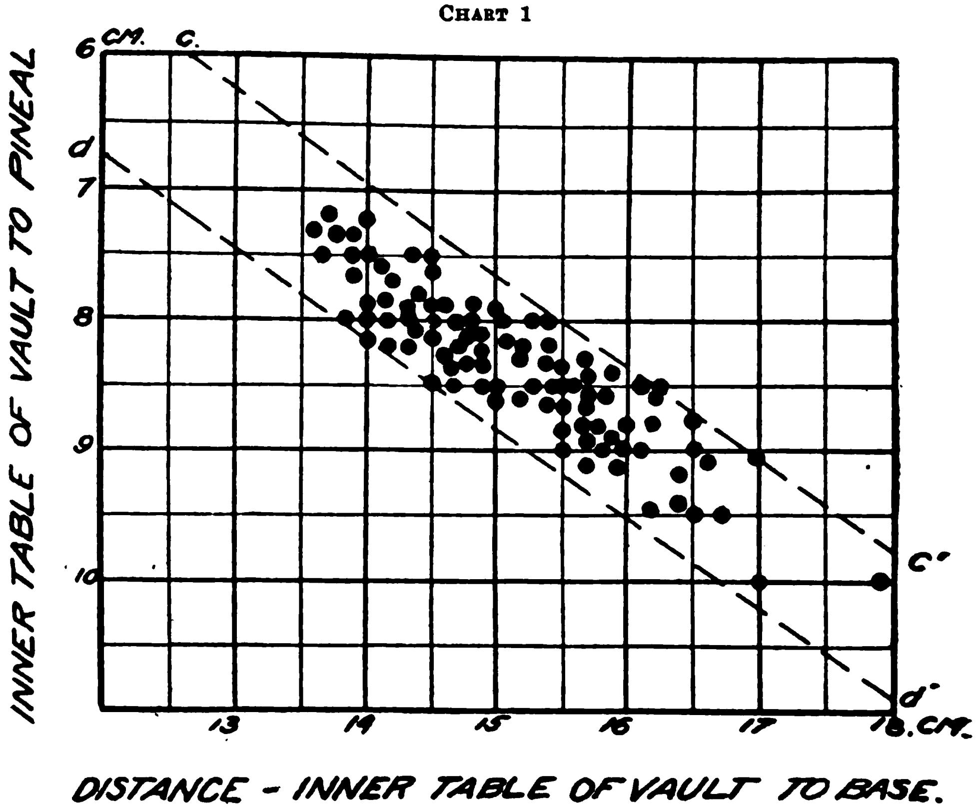


CHART 2

lines *a–a′* and *b–b′* in what they considered the normal antero-posterior variation in position, in chart 1; and to be between the lines *c–c′* and *d–d′* in what they considered the normal vertical variation in position, in chart 2.

Having established their normal curve, they considered that any pineal shadow lying to the left of the line *a–a′* was displaced anteriorly and to the right of *b–b′* was displaced posteriorly, and any pineal shadow lying above the line *c–c′* was displaced upward and any below the line *d–d′* was displaced downward.

In order to estimate the value of pineal displacement, they studied the skull films of 268 cases of verified brain tumors, of which 163 showed calcification of the pineal gland classified both as to location and as to histological types.

| | Cases |
|---|---|
| A. Frontal | 35 |
| Gliomas | 18 |
| Meningiomas | 17 |
| B. Temporal | 15 |
| Gliomas | 13 |
| Meningiomas | 2 |
| C. Parietal | 21 |
| Gliomas | 13 |
| Meningiomas | 8 |
| D. Occipital | 9 |
| Gliomas | 2 |
| Meningiomas | 7 |
| E. Subtentorial | 44 |
| Gliomas | 15 |
| Meningiomas | 1 |
| Acoustic neuromas | 28 |
| F. Pituitary | 29 |
| Cranio-pharyngeal | 26 |
| Pouch tumor | 1 |
| Pituitary adenomas | 2 |

Seventy-one per cent of frontal tumors showed posterior displacement of the pineal gland.

Forty per cent of temporal tumors showed posterior displacement of the pineal gland.

**Forty-seven per cent of parietal tumors displaced the pineal gland downward, and 44 per cent of occipital tumors displaced the pineal gland anteriorly.**

**Thirty-three per cent of the subtentorial tumors had slight upward displacement of the pineal gland.**

In hydrocephalus, 15 cases were received in which only 2 showed the pineal shadow displaced upward.

In 28 cases of pituitary lesions, only 3 showed posterior displacement of the pineal gland.

*Lateral displacement of the pineal gland*

To demonstrate lateral displacement of the pineal shadow from its normal midline position, various mechanical devices have been used to center accurately the head. To insure a true antero-posterior or postero-anterior projection of the skull, Naffziger uses a stethoscope containing a pointer. Sosman employed a pelvimeter fitted with ear pieces and a long pointer, the head being held in position by means of a bandage.

A very simple method of centering the head is by using the nose-forehead position and leveling the head with a finger in each of the patient's ears. The head is then secured by tightening the Buckey bandage.

Vastine and Kinney state, "Since 1923, 23 cases have been reported verified by operation or post-mortem examination, in which the pineal gland has been reported as showing lateral displacement, divided as follows:

| | Tumors |
|---|---|
| Frontal lobe | 4 |
| Temporal lobe | 9 |
| Parietal lobe | 6 |
| Gliomas | 12 |
| Meningiomas | 7 |
| Intracranial hemorrhage | 2 |

"One case of glioma of the cerebello-pontine angle and one with a large acoustic neuroma were observed in which the pineal gland was displaced to the side opposite the lesion. In two cases in which there was intracranial hemorrhage, the pineal shadow was displaced away from the side of the lesion and toward the opposite side.

"It is possible that the pineal gland might be displaced toward the side of the lesion by cicatricial contraction following the organization of the blood clot."

The following brief review of two cases occurring in the surgical service on board the hospital ship *Relief* illustrate the diagnostic value of lateral displacement of the pineal shadow:

FIG. 1.—LATERAL PROJECTION (VASTINE AND KINNEY METHOD OF OBTAINING NORMAL AVERAGE RANGE OF POSITION OF PINEAL GLAND SHADOW)

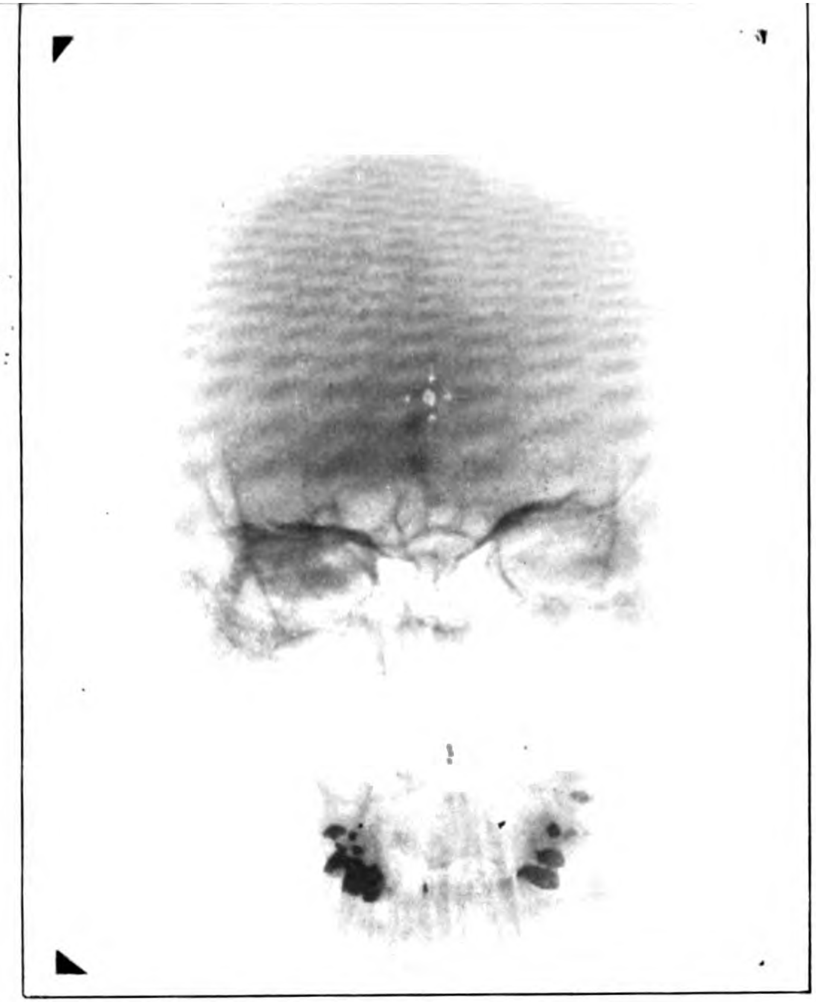

FIG. 2.—ANTERO-POSTERIOR PROJECTION (ILLUSTRATING NORMAL MID-LINE POSITION OF CALCIFIED GLAND)

## Case Reports

Case 1.—Diagnosis undetermined (brain abscess).

*X-ray report.*—Study of lateral view of the skull (stereoscopic) shows pineal gland to be calcified. The sella turcica presents a normal appearance. The cranial sutures are closed, and there is no increase in the vessel or convolutionary markings suggestive of increased intracranial pressure. There is, however, a fairly well-defined fan-shaped area of increased density occupying the right parietal region.

Study of the antero-posterior view of the skull (stereoscopic), shows the pineal gland shadow to be displaced 1.4 centimeters to the left of the vertical plane.

*X-ray diagnosis.*—Brain abscess, right parietal region.

*Operation.*—Osteoplastic flap, right parietal bone. Dura incised, large abscess under considerable pressure drained.

Case No. 2.—Diagnosis undetermined (meningioma).

*X-ray report.*—Study of lateral view of the skull (stereoscopic) shows pineal gland to be calcified. Sella turcica, normal outline. Clinoids depressed, but no sign of erosion. Cranial sutures closed; no increase in vessel markings noted. No suggestive shadow in parietal region.

Study of antero-posterior projection of the skull shows shadow of pineal gland to be displaced to the left of vertical plane.

*X-ray diagnosis.*—In view of certain clinical findings, the displacement of the pineal shadow to the left of the vertical plane is suggestive of a brain tumor located in the right frontal lobe (motor area).

*Necropsy report.*—Brain abscess, 4 by 5 centimeters, right frontal lobe.

## Summary

In the series of cases reviewed by Vastine and Kinney they report that " the pineal gland was found to be displaced in 51 per cent of the patients with gliomas and 57 per cent of the patients with meningiomas.

"Acoustic neuromas was seen to cause displacement of the pineal gland in only 22 per cent of the cases.

" Hydrocephalus per se was observed to produce a displacement of the pineal gland in only 13 per cent of the cases.

" Pituitary adenomas were rarely seen to cause a change in position of the pineal gland, displacement being observed in only 10 per cent of the cases.

" Intracranial hemorrhage was shown to be capable of displacing the pineal gland as observed in 2 cases."

Brain abscess is capable of displacing the pineal gland, laterally and to the side away from the tumor, as observed in the two cases reported by the writer.

## Conclusions

The importance of lateral displacement of the shadow of the pineal gland should be recognized, especially when associated with

characteristic clinical signs and symptoms, and, if possible, confirmed by a thorough neurological examination.

The method of establishing a normal range in position of the pineal gland described by Vastine and Kinney, should prove to be of great assistance in more accurate localization of the various types of intracranial lesions.

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## DENTAL DIAGNOSIS

By T. L. Sampsell, Lieutenant Commander, Dental Corps, United States Navy

Briefly stated, dental diagnosis is the art of determining the exact nature of dental disease. The establishment of a diagnosis may be attempted by hypothesis and by exclusion. A hypothetical diagnosis may be based upon the recognition of the general group of exhibited symptoms and a previous knowledge of the disease conditions which these symptoms predict. It is only accurate to the extent to which the presented symptoms are typical or to which diagnostic points can be recognized. Many diseases are so closely related that they exhibit the same general group of symptoms, but each disease in any group has at least one manifestation which is peculiar unto itself.

In the case of an acute alveolar abscess, the symptoms usually are so typical that this condition is recognized readily; yet not infrequently, due to complications, it is confused with other diseases exhibiting the same group of symptoms. Most disease processes are complex, involving more than one tissue or exhibiting atypical symptoms which often obscure the diagnostic points to such an extent that a hypothetical diagnosis is impossible. In these cases, symptomatic treatment should be instituted until a diagnosis can be worked out by exclusion.

Diagnosis by exclusion consists in listing the entire nomenclature of diseases within the range of possibility, and the gradual elimination of those not concerned. Some will be excluded negatively, while others will be positively excluded; i. e., certain conditions will be found which point to normality of suspected tissue, while others will be found which will show pathological involvement beyond all doubt.

Let us consider a case of acute alveolar abscess, the patient having presented himself at that particular stage of the pathological progress before the rapidly forming pus has been walled off, with all of the cardinal symptoms of inflammation, but no fluctuating pus, and with a history of traumatic injury. An acute alveolar abscess or a fracture is indicated. Palpation and manipulation of the bone, although painful, fails to reveal the slightest crepitus, nor is there any deviation from normal in the bone continuity. This positively excludes the possibility of fracture, especially when checked with radiographs. The jumping, throbbing pain of pulpitis having ceased at the end of 24 hours, the possibility of simple pulpitis is ruled out and an alveolar abscess is indicated.

The tooth which has given the greatest response to the various tests is then opened and is drained of pus, thus proving the diagnosis. We have started with a hypothetical diagnosis, based on typical symptoms, have excluded the possibility of fracture created by the case history, and have identified the pathology by finding pus. By hypothesis and exclusion we are able to distinguish the true nature of the pathological involvement and to make an accurate differential diagnosis. This proceedure must be followed in all cases from the simplest to the most complicated. Its conclusions are based on clinical and laboratory findings, some simple, some complicated, but all essential.

An accurate methodical examination is the only rational basis of diagnosis in complicated or atypical cases. This should be conducted in three stages:

(1) The clinical examination.
(2) The history taking.
(3) The laboratory examination.

The most important of the three is the clinical examination. The dental surgeon is frequently able to see at a glance the cause of trouble, for the reason that the great majority of dental troubles are caused by caries, and caries usually is easily discernible. The X ray is the instrument of final resort in locating caries, as it readily reveals carious areas and cavities, which can not be seen nor located with an explorer. In making the examination every finding should be recorded. Standardized charts should be used for this purpose and carefully filed.

The teeth should be examined and the findings noted. Graphic notations are much more comprehensible and satisfactory than notes. The system in use in the United States Navy has proved highly efficient and satisfactory.

The pharynx, fauces, and tonsils should be inspected, together with the soft palate and surrounding soft issues, and any lesions which do not belong strictly to the province of dental surgery should be

referred to the physician. Following a searching clinical examination the case history should be taken. The patient should be questioned along every line which might possibly furnish a clue to the cause and nature of the disease. Many cases which present no objective symptoms will yield so many subjective ones that the diagnosis can be made at this point without further examination. Trifacial neuralgia is an example of such a case. The case history of a patient who is afflicted with this disease will always point to the true diagnosis. The patient's age, childhood diseases, family history, and any systemic disturbance which might be the cause or result of the condition should be noted. Habits of life, diet, rest, recreation, and mental relaxation should be considered. The frequency with which simulated nervous conditions can be directly traced to bad habits that lead to melancholic mental processes is quite surprising. Any information which can have the slightest relationship to the case should be noted. This should be kept on a separate chart and constitutes the second step in making a diagnosis. The next step is the laboratory examination. The more important phases of this examination to the dental surgeon must necessarily be the radiographic and dark-room examination. In transillumination, dental attention will be focused on the maxillary antrum, but the alveoli and frontal sinus should be examined as well.

Microscopic examination of blood smears will many times be the deciding factor in making a diagnosis, and the dental office should possess a good microscope. Nothing is more helpful in the treatment of Vincent's disease than the daily checking up with blood smears. White counts and general bacterial examinations are best done by specialists, but the dental surgeon should be in a position to know when the more elaborate examination is indicated. Specimens of saliva and of the excretions should be taken in complicated cases.

At this point it will be well to digress and give thought to the annoying situation which unfortunately still exists between the mother science, medicine, and one of its specialties, dentistry. There is a great lack of cooperation between the two classes of practitioners. No attempt can be made in this work to discuss this deplorable condition, but the dental specialist can do much to remedy it, by calling in his medical brother whenever occasion demands, instead of ignoring or attempting to treat a condition for which the medical practitioner is better fitted. The need of cooperation is more apparent when the stage in the search for a diagnosis, where circumstances necessitate examinations along general medical rather than special dental lines, is reached.

After all steps in the examination of a patient have been carried out, all data obtained are correlated and the process of exclusion carried on until the true nature of the disease is revealed and the

diagnosis made. Complete examinations can be made only with complete equipment. The dental surgeon can not be expected to provide himself with all the needed instruments and appliances to diagnose all cases, nor can the medical man be expected to equip his office with a large supply of purely dental instruments. The wise dental surgeon will ally himself with a group of specialists, each of whom is equipped to take care of his end of an examination. This arrangement minimizes expense, accelerates examination and diagnosis, and gives the patient thorough service. It is ideal in all respects. Certain instruments which are commonly considered superfluous are in reality quite essential if the dental examination is to be worthy of the name. The X-ray machine is one of them. No office can afford to be without a set of cold lamps and a pulp tester. These are not indispensable, but the time they save and the thoroughness for which they provide quickly compensate for the expense involved in their purchase.

The microscope is worth its weight in gold. Accompanied by a few bottles of staining dye and a handful of slides, it tells a story of minute pathology which can be obtained in no other way. Last, but not least, among diagnostic instruments is the current literature, both medical and dental. So many new things are being constantly brought to light, so much new knowledge is constantly being reported, that all our cases must be considered in the light of latest developments.

Thus, in our attempts to diagnose our cases we must pursue the following procedure:

(1) Clinical examination—Chart.
(2) Case history—Notes.
(3) Laboratory findings—Notes.
(4) Consultations (medical and dental)—Notes.

Usually the diagnosis can be made without going through this whole procedure, but in baffling cases this routine will be found essential. In most cases diagnosis determines treatment. If the cause and nature of a disease condition be clearly comprehended, the method of treatment is usually indicated. There are some diseases, however, which still resist all attempts at cure, but these are mostly in the field of general medicine. Incurable dental diseases are very rare, and are becoming more so with succeeding years. Pyorrhea, the great bugaboo of the dental profession, is yielding rapidly to treatment based on knowledge of the underlying principles. It is quite possible that the next few years will see the eradication of this particular malady through extension of the practice of orthodontia.

Rational therapeutic treatment is always based on diagnosis. Correct treatment, in every branch of medicine, is followed by rapid response and ready cure. Those diseases which remain chronic or

incurable at the present day are simply awaiting the development and discovery of more knowledge concerning them. They, in turn, will yield in time to the progress of medical science, but it is essential that the practitioner know at all times what method of treatment to pursue.

In general, treatment may be classified under five heads:

(1) Palliative—symptomatic.
(2) Provocative—diagnostic.
(3) Medical—chemical.
(4) Surgical—physical.
(5) Mechanical—orthopedic.

Palliative treatment consists in treating the symptoms as they appear until a diagnosis can be made or until they subside. It is a makeshift treatment instituted for the sole purpose of relieving pain, and should be continued only until a method of permanent cure can be instituted. A common example of palliative treatment is the application of sedatives in acute pulpitis. Most of the aromatic oils will soothe a congested pulp or at least diminish the pain, but the surest cure for an aching pulp is the excision of the pulp itself. This treatment has its drawbacks in that it may set up a more vicious disease than pulpitis, but at least it is a permanent cure for pulpitis.

Provocative treatment is much used in the realm of dentistry. Its purpose is to accelerate diagnosis. When diagnosis is difficult, it is sometimes necessary to aggravate subacute or subjective symptoms for the purpose of finding a possible diagnostic point. The most common example of provocative treatment is the exploring of a pulp chamber with a smooth broach. A case of deep-seated caries may or may not be accompanied by a live pulp. Sometimes these carious teeth are aching when the patient presents himself; sometimes they are not. Excavation reveals an exposure, but the pulp has receded and does not show, nor does it ache or bleed. The condition of the pulp must be known. This knowledge is gained by going gently through the orifice of the exposure with a smooth broach. If the broach provokes pulpal pain, there is living tissue to deal with; if not, there is putrescent or necrotic tissue. Provocative treatment is for diagnostic purposes only. When the desired information has been obtained, rational treatment is immediately instituted, consisting of the application or administration of drugs or surgical intervention.

Medical treatment consists in applying locally or administering internally drugs or chemicals for the effect of their actions or reactions either locally or systemically. Cases exhibiting systemic symptoms are usually best treated by internal administrations. Syncopes produced by psychic shock usually respond rapidly to the effect of internally administered aromatic spirit of ammonia.

Surgical treatment consists of removing the cause of disease by excision, or rebuilding lost tissue by plastic or restorative means. It embraces all mechanical means of invading tissue for the purpose of eradicating disease or anatomical defect. It is divided into—

(1) Incision.
(2) Excision.
(3) Transplantation.
(4) Replantation.
(5) Implantation.

Incision is the simple invasion of tissue, usually for drainage purposes, as the lancing of the so-called "gum boil." Excision is the invasion of tissue for the purpose of removing pathological tissue. Extractions, curetments, and the removal of hypertrophied growths are common surgical procedures. Transplantation is the taking of tissue from one part to supply a defect in another. This is called plastic surgery. Replantation of healthy tissue lost through accident is often tried and at times successful. Teeth can be replanted successfully but the replantation must be accomplished soon after the unseating of the tooth or the chances of success are nil. Strong antiseptics and germicides are contraindicated in this operation and reliance must be placed on the normal defensive and restorative forces. Salt solution is by far the most acceptable bath for a tooth awaiting replantation. Dental implantation is a hopeless procedure at best. It consists in attempting to seat a tooth from one mouth into another. There are cases of reported success in this operation but not of recent origin. In the olden days, poverty-stricken persons were wont to sell their sound teeth for this purpose, but modern dental science has driven this practice out of existence.

The simple operation of filling a tooth consists of:

(1) Incision—opening up cavity.
(2) Excision—removing decay or pathological tissue.
(3) Medical treatment—preventive or therapeutic.
(4) Restorative—the mechanical restoration of lost structure

While simple, the operation of filling a tooth is essentially a surgical procedure and as close an approximation to surgical cleanliness as possible should be achieved. Treatment then is to be governed by diagnostic findings. Treat the symptoms until a diagnosis is made, then use the methods indicated for permanent cure. When surgery is indicated it is far better to operate before tissue degeneration begins. The basic proof of correct therapeutics lies in the response to treatment. If the case does not yield readily to treatment one of two things is wrong, the diagnosis or the treatment.

Prognosis is the ultimate decision concerning the end result of a case. If a correct diagnosis has been made, the probable outcome is usually obvious, but many complications may occur to change a prognosis from favorable to hopeless. The general health of the patient has much bearing on the outcome of the case. The resistance of a strong, healthy patient will be greater than that of one of the opposite type. Temperament, too, should be taken into consideration, and a great reliance should be placed in nature. The patient should be told as early as is possible of the probable outcome of the case. Tact should be used in the telling if the prognosis be unfavorable, but only in rare instances is it justifiable to keep the patient in ignorance of his condition. Diagnose the case, institute the proper treatment, and in most cases the ready response which will be exhibited will permit the declaration of a favorable prognosis immediately.

### Case Report

Patient: Male, well built, well nourished, sandy hair, aged 25.

*Complains* of sharp pain in lower left first molar.

*Physical examination.*—Lower first molar normal—no caries, no abrasion, no pericementitis, responds to vitality test. Adjacent teeth same.

*Conclusion.*—It can not be the molar; it is something else. When told to describe the pain, patient says, "Sharp, at times throbbing, radiates over supraorbital and temporal region."

*Indicatory.*—Pain in the supraorbital and temporal regions must be a reflex from nearest branch which is maxillary division of trigeminal (second branch). Examine maxilla.

*Physical examination.*—Upper second molar, same side, shows undermined enamel which, when chiseled away, reveals large underlying cavity with pulp exposure.

*Diagnosis.*—Pulpititis, acute, with reflex manifestations.

*Treatment.*—Pulpectomy and restoration.

*Prognosis.*—Favorable, will yield readily to treatment.

This is a typical practical case of a type which quite frequently presents itself to the dental surgeon. It may baffle for a moment or two, but the case history begins immediately to point out its true nature.

An analysis of the evidence presented gives the following deductions:

Point of localization complained of proves absolutely normal. Every tooth supplied by same nerve branch is likewise normal, therefore this must be a reflex. A reflex must include nearest glanglion, which is Meckel's, the maxillary division's substation lying back in the spheno-maxillary fossa.

The sharp, at times "throbbing," nature of the pain indicates the probability of pulpitis. Pulpitis usually means a cavity with attendant exposure of dentine or pulp. Therefore the logical thing to do is to look for caries along the maxillary division of the fifth.

The caries is found, the cavity opened, cleaned, and a sedative applied. The pain ceases shortly thereafter. At appointment time the next day it has not returned, which is a positive check on the diagnosis of "acute reflexing pulpitis" made when the caries was found.

The treatment is obvious; excise the pulp, clean and fill canals, and restore lost structure.

The prognosis can be made immediately. The excision of the pulp will prevent future pain; clean surgery of live tissue is mostly successful, and obvious mechanics are the easiest part of the job. The case is thoroughly understood from start to finish. (A DIAGNOSIS HAS BEEN MADE.)

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## RABIES IN HAITI

By G. C. THOMAS, Lieutenant (Junior Grade), Medical Corps, United States Navy

Rabies, as is well known, is present in practically every civilized country of the world. It is more prevalent in some countries than others, especially where man and dog live more in common. This is especially true among the black race. The annual toll of deaths from rabies is appalling, taking into account the fact that the disease is preventable if proper measures are instituted in time. The prevention of the disease is entirely a public-health question and requires systematic organization and strict enforcement of proper laws. It is true that rabies may be transmitted through the medium of all warm-blooded animals, but the majority of cases are contracted from the bite of the dog. The disease exists throughout the island of Haiti and Santo Domingo in a very virulent form. Three cases of death have been reported from Haiti during the last two years, and there were probably many more unreported cases, especially in the rural districts where the cause of death is usually difficult to determine.

A census of the dogs in Haiti is almost an impossibility, but their number runs well into the tens of thousands. Practically every Haitian family owns at least one dog, and it is not uncommon to find as high as four and five belonging to one family. The white population is almost as bad in this respect as the natives. One of the writer's neighbors, with four children, owns three dogs, and it is not uncommon to see as high as eight and ten dogs around his home at meal time, especially in the evening.

### MEASURES FOR CONTROL

About a year ago the Haitian dog law, requiring every dog in the Republic to be licensed, was passed. The law also stipulates that

when a dog is licensed it shall be inoculated with antirabies (one inoculation) vaccine. On September 1, 1927, about one year after the passage of the law, there were only about 400 dogs licensed in the district of Port au Prince.

The National Public Health Service of Haiti maintains a dog-catching department which, since the passage of the law, has averaged about 300 dogs per month. One notices a very marked diminution in the number of dogs seen about the streets, and especially about the public market places. The dogs after capture are held for a number of days and then killed in the following manner: The exhaust pipe from an automobile is connected to an air-tight box containing the animal. Death occurs in a very short time (carbon monoxide gas). This is probably the cheapest and most humane way of killing dogs that has ever been used in this country.

*Antirabies vaccine.*—It has been our experience that the antirabies vaccine is not infallible and that it is possible for a supposedly immune dog to contract rabies. A thorough check has been made during the past year on the number of dogs (those that received the vaccine) contracting rabies and we found that three of them developed a very virulent form of the disease. Two were killed by the police and one died a typical rabic death while being held under observation. All proved positive on examination. The use of the vaccine has undoubtedly cut down the number of cases of rabies, especially among the inoculated animals.

A great deal of difficulty has been encountered with everyone, both natives and white population, in getting across the idea that if they will have their dogs licensed and inoculated with the antirabies vaccine, much can be accomplished toward lowering the number of cases of rabies. Although the license fee is only 60 cents gold, only a very small percentage of the dogs in Haiti have been licensed.

Again it has been difficult to teach the natives, especially the native police, that a suspicious dog, especially those that have bitten persons, should not be summarily killed, but should be apprehended and turned over to the proper authorities. If killed, the head should be sent to the public health laboratory at Port au Prince for examination. In the great majority of cases the dog is killed, and it is these cases that give the laboratory the greatest difficulty. Many times the heads reach the laboratory in such poor condition, either from decomposition or because the brain is badly macerated from high-power bullets, that it is almost impossible to examine them. Animals thus killed are usually in the early stages of rabies and may fail to show any microscopic evidence of the disease, thus causing an indefinite delay in awaiting inoculation tests.

LABORATORY PROCEDURE IN THE DIAGNOSIS OF RABIES IN DOGS

1. *Demonstration of Negri bodies in brain smears.*—One can find in the literature many methods for the demonstration of Negri bodies in brain smears, but the basis for practically all of them appears to be a combination of two common stains, i. e., basis fuchsin and methylene blue.

The method used in the public health laboratory of Haiti for the demonstration of Negri bodies in brain smears is as follows: The skull cap is removed in the usual manner, care being taken not to macerate the brain. The entire brain, including the cerebellum, is removed. An incision at a point about 1 centimeter from the midline of either hemisphere is then made, using a thin-bladed, sharp knife. The brain is opened down to Ammon's horn (we have had very little success with material from the cerebellum). This structure runs almost at right angles to the line of incision and almost beneath the point of beginning of the incision if one cuts from behind forward. The thin layer of white matter which covers the horn is opened and pushed aside. A small piece of the gray matter is placed upon a clean slide, a second clean slide placed directly upon the tissue, and even pressure is exerted upon the two slides until the tissue flattens out. The two slides are then drawn apart. Pressure must be maintained until the smear is complete. Much practice is required in order to obtain uniformly even smears. The smears, while still moist, are fixed in methyl alcohol for one to two minutes and then stained in the following manner: The slide is flooded with a mixture consisting of 20 cubic centimeters of distilled water, 1 drop of a saturated alcoholic solution of basic fuchsin, and 1 to 2 drops of a saturated aqueous solution of methylene blue. (The preparation of this mixture requires quite a bit of practice in order to get just the right proportion of methylene blue, as too little makes the ganglion cells too red and too much makes the cells too blue, sometimes almost black.) Gently steam (do not boil) for three to four minutes, wash in water, and dry betwen filter paper. Ganglion cells stain blue, the shade depending upon the amount of methylene blue added; red blood cells, a yellowish copper color; Negri bodies, a pale pink to a deep red. The Negri bodies are often large enough to be seen with the low-power lens. One should make and stain from 10 to 20 slides in order to obtain enough good slides to be certain of the diagnosis. The writer has frequently stained as high as 30 slides in order to obtain 1 or 2 slides that show a large number of ganglion cells.

The largest forms of Negri bodies measures about 20 microns and the smallest about one-half micron. They are round, oval, oblong,

and triangular, but the first type is by far the most common. Their structure is shown especially well in smears. The bodies present a hyalinelike cytoplasm with a clear margin and contain one or more chromatin bodies having a more or less complicated and regular arrangement. It is not at all unusual to find these bodies missing from the Negri bodies. Negri bodies vary in number according to the stage of the disease and are located chiefly in the cytoplasm and along the fibers in the branches of the large nerve cells of the central nervous system. It is not uncommon, especially with a large number of ganglion cells infected, to find them free in the brain substance.

2. *Animal inoculation; usually rabbits.*—The final diagnosis of rabies rests upon animal experimentation. The other half of the brain is opened in a like manner as for making smears. When the horn is reached sterile instruments should be used to open it. A small portion of the gray matter is removed, emulsified in sterile salt solution, and injected under the dura mater of a rabbit or guinea pig. The diagnosis by this method, however, requires so much time that it is of no practical value in deciding whether the Pasteur prophylactic treatment should be given. If the inoculated rabbit shows no symptoms in one month and Negri bodies were not found in the specimen, a negative diagnosis may be given, although it is customary to observe the animal for six months.

During the past two years 60 dog brains have been examined in the public health laboratory of Haiti, with the following results: 38 positives, 15 negatives, and 7 doubtful cases. All the heads were from dogs with suspicious histories, although not all had bitten anyone. Three dogs that were held under observation died without showing any symptoms of rabies, but on examination proved to be positive.

### TREATMENT OF DOG BITES (SUSPICIOUS AND OTHERWISE)

1. *Local treatment of the wound.*—Wounds produced by the bite of an animal in which there is any suspicion of rabies should at once be cauterized with fuming or strong nitric acid. Nitric acid applied directly to an open wound is very painful and should be preceded by some form of treatment to eliminate the pain. The method in use throughout the island at the different clinics is as follows: The wound is first cleaned as thoroughly as possible, then pure carbolic acid is applied, using a thin glass rod and touching all parts of the wound, then wash with alcohol. Strong nitric acid is then applied to all parts of the wound, care being taken that no pockets nor recesses escape. The excess nitric acid is neutralized with a saturated solution of sodium bicarbonate. Thorough cauterization at once reduces the danger of wound complications and wounds so treated within the first hour seldom are followed by rabies.

2. *The Pasteur prophylactic treatment.*—When should it be given? This is a very important question and it is sometimes difficult to decide whether or not the treatment should be given. Treatment causes sufficient personal inconvenience to make it undesirable to give it if it is not necessary. In many cases it is impossible to discover whether the dog that inflicted the bite is mad or not, and in these cases it is best to play safe and advise the treatment. This is especially true in a country where rabies is prevalent.

The patient comes in with a history which usually comes under one of the following classes:

(1) The dog is mad. Confirmed by symptoms and laboratory examination. Give the treatment.

(2) The dog is not mad. It should be observed for a period of 10 days and if no symptoms develop the treatment is unnecessary. The dog, however, should be kept in quarantine for a sufficient length of time to avoid its being bitten by a rabid dog and subsequently developing rabies, making your original diagnosis doubtful.

(3) The dog is not identified. In this case it is best to give the treatment unless the locality is known to be free from rabies.

(4) Exposure to saliva. Many people who apply for advice give the following history: They have not been bitten but have been licked on the hands and face by a dog that later developed the disease. One usually has minute abrasions upon the hands and it is best in these cases to advise the treatment.

The principle of the treatment consists in producing an active immunity by means of an attenuated virus. This virus is contained in the spinal cord of rabbits dead of rabies and is attenuated by drying. An emulsion of this material is given daily for a period of 14 days.

There are no contraindications to the treatment. During the treatment the patient may go about his usual business. It is not necessary to stay in bed, but he should avoid fatigue, cold, emotional stress, trauma, and alcohol.

### COMPLICATIONS OF THE TREATMENT

1. Local reactions at the site of the wound are trivial and usually consist of a slight redness and some induration.

2. Paralysis is said to occur occasionally and may be fatal. We have never had the slightest sign of paralysis in over 200 cases.

3. In several cases a rise of 1° to 2° of temperature has been noted, accompanied by headache and in one case by a feeling of nausea.

### DURATION OF IMMUNITY

Immunity is said to appear about two weeks after treatment and to last a varying period of time, at least for two years. But it is

believed advisable, especially in countries where virulent rabies is present, for one bitten by a rabid dog six months after the last treatment to again take the Pasteur treatment.

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## NOTES ON A MALARIA SURVEY AT PORT DE PAIX, HAITI[1]

By P. W. Wilson, Lieutenant Commander, Medical Corps, United States Navy

When I left Port de Paix, the final figures on the malaria survey of the emigrants leaving for Cuba had not been prepared, but the approximate figures were as follows: Of the 6,400 laborers examined 26 per cent showed malaria parasites in a single thick-film blood smear. Of those infected, 80 per cent showed parasites of the malignant tertian type, 19 per cent quartan, and less than 1 per cent benign tertian. Relatively few mixed infections were noted. If there had been time or opportunity to examine the blood of the laborers on two consecutive days, it is assumed that certainly more cases of mixed infection would have been found, and it is thought also that the total number of those infected would have been increased by from 5 to 10 per cent. The surprising thing, of course, is the very small amount of benign tertian. During the first few days of the survey there were a number of benign tertian cases reported by each of the examiners, but on more careful study they became more conservative and only three or four cases of benign tertian were reported during the last three weeks of the work. On those few cases the several examiners were never unanimous, but all yielded to the opinion of Doctor Barbour, whose international reputation and long experience in malaria work naturally placed him in the position of arbiter.

Another fact which surprised those of us who were conducting our first malaria survey was the large number of men who showed heavy infections, some of them having as high as 50 to 70 rings to the field. It was a quite common finding to see specimens with 4 to 6 parasites to the field. All the prospective emigrants were first examined physically, and those who were weak, sick, infirm, or too young were rejected. Blood smears were taken only on those who were allowed to go and who were in apparent good health.

Three groups of children were examined; one group of 100 from the market place at St. Louis du Nord, in whom malarial parasites were found in 28 per cent; another group of 100 street children in Port de Paix, who were 24 per cent positive; and a third group of 67 students of the Brothers' school at Port de Paix, who were 14 per cent infected. The ratio of quartan to malignant tertian infections among the children was approximately the same as that noted among

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[1] Read before the Société de Medicine, Port au Prince, Haiti, March, 1927.

the emigrants. No benign tertian was found. It is interesting to note the low rate among the students as compared with the other two groups. Three factors may have a bearing on this difference. First, it was impossible at the time to examine more than the 67 who could be collected, and it is possible but not probable that there would have been enough positives in the last 33 to bring up the rate if we had succeeded in getting blood from 100 students. Second, the school children came mostly from Port de Paix, and the sanitation of the town itself may be the important factor. But the third factor is perhaps equally important, and that is, that the students came from the better class, and consequently were much better nourished. One should also consider that, perhaps, the better class of children from the school had had more quinine than the others, they being close to the source of supply and having the money to purchase it.

Perhaps it will not be amiss to say a few words about the Barbour and Komp thick-film method. This method was used exclusively, and while it would be a waste of time to give the technique in detail, certain precautions which Barbour and Komp have found necessary, if good uniform results are to be obtained, will be mentioned. Two prime essentials in the preparation of thick films are: First, avoidance of dust or finger dirt. To clean the finger or ear well requires but little time, perhaps four or five extra minutes, for a group of 25 to 30 persons. The blood drop should be spread by dragging it about on the slide, not by rubbing the finger in it. Varying thickness in the depth of the drop is an advantage. The amount of the blood spread may vary, but it is well to have at least one-fifth of a cubic centimeter. Second, a good quality of Giemsa stain is also essential. Gruebler's powders are used exclusively, and the stock stain is made up according to the usual textbook formula. Chemically pure glycerine and chemically pure methyl alcohol are necessary. The stain which was used at Port de Paix contained only the azur II eosin in the usual amount; no azur II was added.

Other details are worthy of mention: Freshly distilled water, or rain water caught in the open, is satisfactory, but care must be taken that it does not become acid in reaction through absorption of $CO_2$ or the growth of algæ. The stain works best when the hydrogen ion concentration of the water is between 7.4 and 7.8. It is best to make up only enough stock stain to last three or four weeks. When slides are well cleaned one usually has but little trouble through failure of the thick film to adhere to the slide. It is best to wipe the cleaned slides with a cloth moistened in alcohol before using them. A few hours' drying of the blood will make the films adhere better and the slides may be placed in the sun. Care must be taken, however, not to allow too much heat or the film will harden to such an

extent as to interfere with dehemoglobinization. For the same reason the slides should not remain unstained for more than two or three days. The slides should be decolorized too little rather than the least bit too much, and Clark prefers not to decolorize at all. Glassware must be kept exclusively for this work, since any contamination with acid substances may spoil a whole batch of slides. If such an accident should happen, it is easy to decolorize and restain.

There can be no question but that the thick-film method is a great timesaver and that a great many more positives are found with the thick than with the thin film preparations. In hospital practice five minutes is considered to be sufficient time to spend on a slide before reporting it negative, while in survey work three minutes is sufficient. In any case the finding of chromatin granules, pigment, or even anemia would lead one to prolong the search. In the work at Port de Paix the first parasite was found in the first 30 seconds of search in more than 40 per cent of the positives, and about 80 per cent of the positives were found before 50 fields had been examined, using a No. 10 ocular—or, roughly, within the first minute and a half.

There can be no doubt but that in the hands of skilled observers the thick film is much more accurate. Clark, working with his technician in Honduras in the spring of 1924, examined 1,431 blood films, he using the thick film and his technician the thin preparation. The Barbour thick film gave 45.8 per cent positive results, and the ordinary thin film gave 17.5 per cent. Three hundred and fifty of these examinations were positive to the thick film and negative to the thin film. Thirty of the examinations were positive to the thin film and negative to the thick-film method, and Clark summarized the advantages and disadvantages of the thick-film method at the Kingston conference in 1924 as follows: "(1) It reveals the adult parasites when only a sparce infection is present. (2) It helps identify the type, in cases where perhaps only one or two young ring forms are found in a thin film, by affording an opportunity to see some of the adult forms. (3) It furnishes a much more accurate idea of the incidence of malaria. The disadvantages are: (1) Young ring forms are difficult to stain because they contain little, if any, pigment. (2) The thick films are easier to lose off the slide than the fixed thin film. (3) Anemic blood is difficult to prepare in thick film and easy to lose in water jars. (4) It is difficult—much of the time, impossible—to differentiate benign tertian from quartan parasites. (5) A positive thick-film report given a medical officer in charge of natives in the Tropics sometimes misleads the clinician and prevents, or delays, the recognition of the primary disease that brings the patient to the hospital. A doctor new to the Tropics is apt to find difficulty, for a while, in differentiating an acute malaria from a chronic

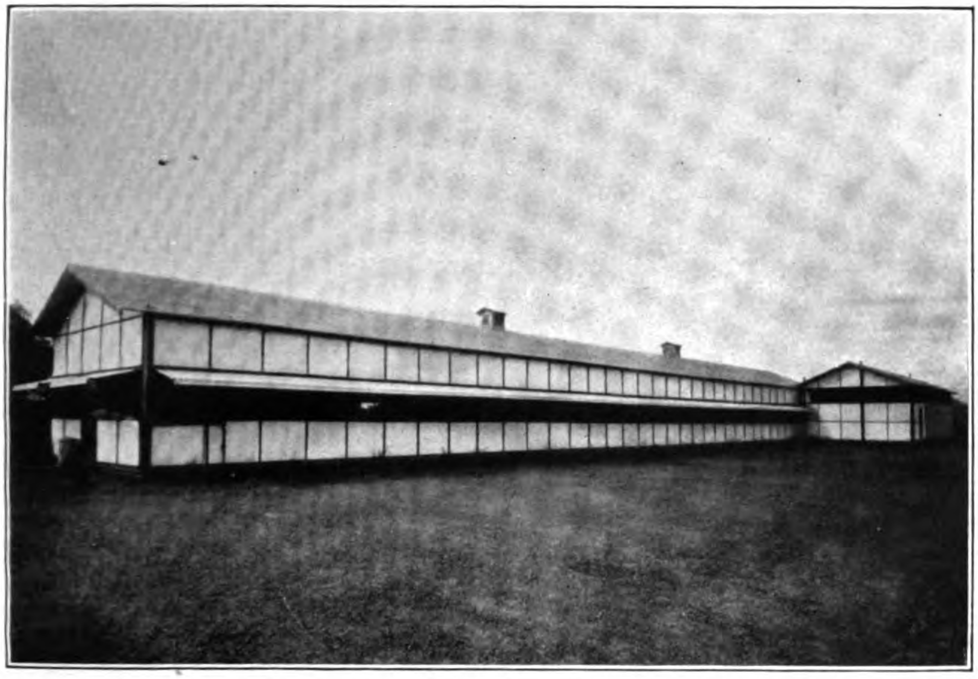

FIG. 1.—EXTERIOR OF FOUR-UNIT WARD BUILDING AND LAVATORY UNIT AT U. S. NAVAL HOSPITAL, PEARL HARBOR, T. H.

FIG. 2.—INTERIOR OF BUILDING SHOWN ABOVE

322—1

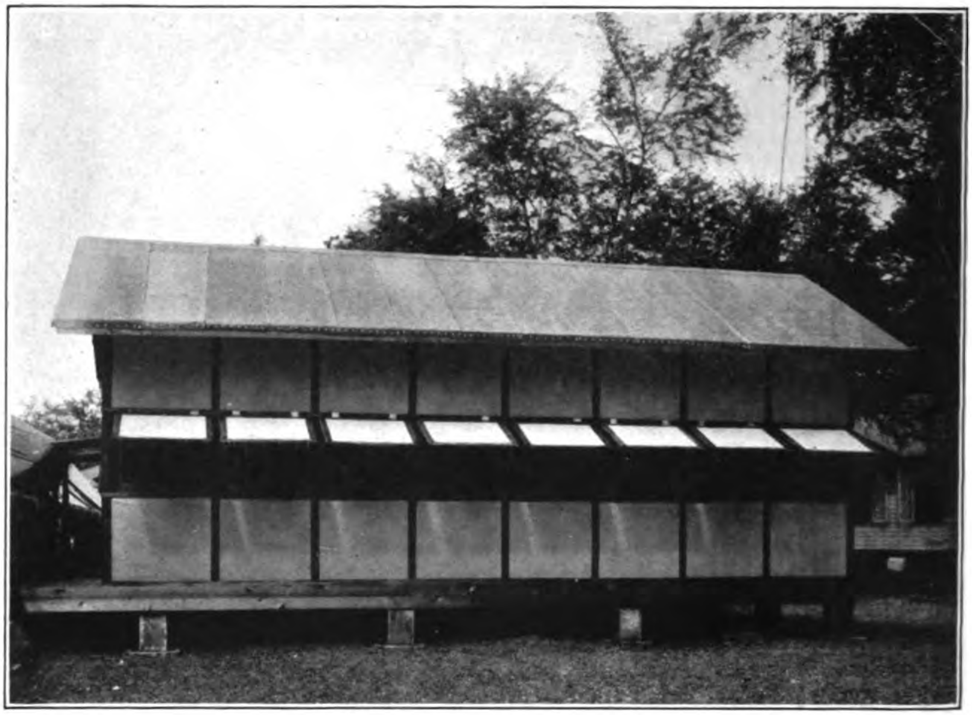

FIG. 3.—EXPERIMENTAL UNIT ERECTED AT U. S. NAVAL HOSPITAL, CANACAO, P. I. NOTE CANVAS SIDE WALLS AND RUBBEROID ROOFING

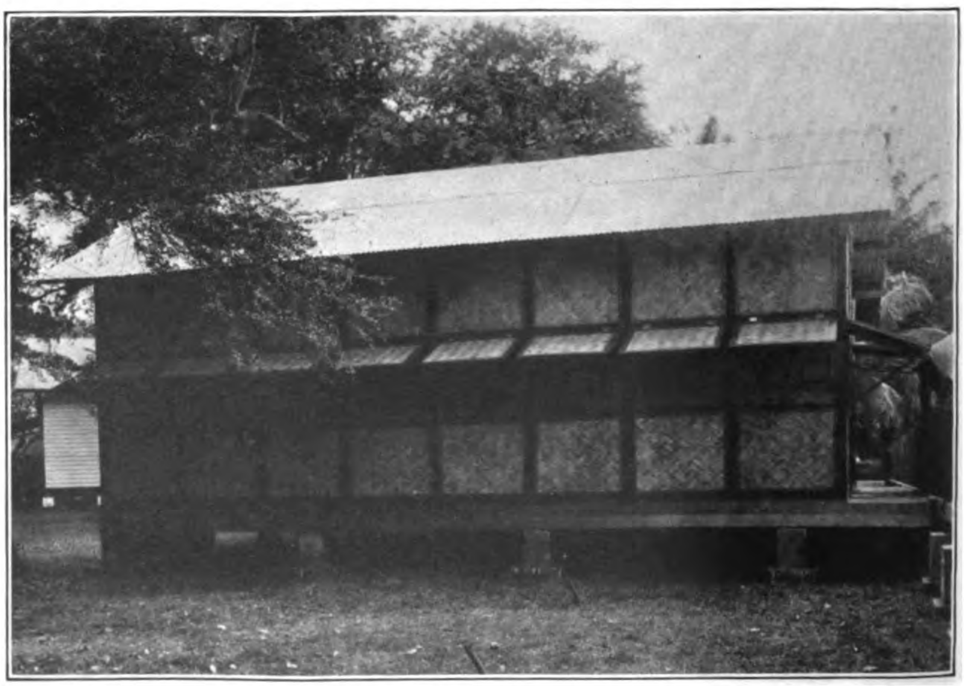

FIG. 4.—EXPERIMENTAL UNIT AT CANACAO WITH SUALI SIDE WALLS AND CORRUGATED IRON ROOFING

322—2

or latent case. (6) The thick film requires more experience in its examination than does the thin-film picture with its good background of red cells."

In conclusion, I wish to state that it is my opinion that in hospital practice in this country the blood of every newly admitted patient should be examined by the thick-film method for malaria as a matter of routine, and if found negative a second examination should be done on the following day. Certainly malaria parasites will be found in many patients presenting no malaria symptoms, and who are not actually suffering from their malaria parasites which they may have harbored for many years, but if the doctor in charge of the case is forewarned he is forearmed. The surgical case can be better prepared for his operation, and in the expectant mother who carries malaria parasites in her blood stream, it must always be remembered that malaria itself causes more miscarriages than quinine in reasonable dosage ever does, to say nothing of those obscure cases of anemia, pain in the back, neuralgia, digestive and other indefinite disturbances, which frequently clear up when the proved malaria is carefully treated over a sufficient length of time. Of course, in time, probably the greatest benefit to the community will be derived from the careful sanitation done in those neighborhoods whence the carriers come, and from more intelligent sterilization of the carriers themselves.

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## EMERGENCY HOSPITALS, UNITED STATES NAVY MEDICAL DEPARTMENT STANDARD HUTMENT TYPE

By A. B. MONTGOMERY, Chief Pharmacist, United States Navy

In time of a national emergency when the naval Medical Department will be required to furnish hospitalization in excess of the capacities of existing facilities, even when expanded to their limits of expansion, the Bureau of Medicine and Surgery plans to construct and equip emergency hospitals, simple in construction and equipment, of the United States Navy Medical Department standard hutment type, when practicable. The policy of the Medical Department is not to use civil institutions except when absolutely necessary.

During the World War, when the Navy was called upon to expand to more than ten times its pre-war strength, the question of hospitalization became a serious one, not only to meet the immediate requirements of mobilization, but also the requirements of increasing strength during the war. Not only were naval hospitals called upon to expand to the limit of their buildings and grounds; it was also necessary to construct base hospitals and smaller station hospitals at

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home and overseas. It is interesting to record that the Bureau of Medicine and Surgery had prepared for such an emergency by having for immediate use type plans of acceptable building construction to be used for wards, Hospital Corps quarters, etc.

At New York City, even with a greatly expanded naval hospital, a large venereal hospital in the harbor on Hoffmans Island, and one of our finest emergency hospitals at Pelham Bay, it was necessary to use civil hospitals; and after the armistice there were nearly 3,000 patients in these hospitals in different parts of the city.

The disadvantage of using civil hospitals was, however, very apparent at the time of the great "flu" epidemic, when the beds of these hospitals were needed for civilian patients. The use of these hospitals was also found to be costly, and men accustomed to military discipline were difficult to control in them; consequently, it is not considered a wise policy to include civil hospitals in plans for a future emergency, but to plan for the immediate expansion of existing facilities and the establishment of temporary or semipermanent hospitals when necessary.

As an indication of the possible requirements in a national emergency, the facilities for hospitalization during the World War may be used as a guide. The principal emergency hospital construction in the United States during the World War, at 25 bases, of entirely different size and requirements, comprised an aggregate of 500 buildings to accommodate 15,000 patients and the necessary personnel—Hospital Corps men, nurses, and civil employees—to the number of 6,000 additional, so that the total accommodations furnished in beds and living spaces were for 21,000 persons. This does not include the accommodations furnished by taking over buildings for this purpose, nor the many isolated bases where small station hospitals were established. Overseas there were established five base hospitals and eight station hospitals, with a total bed capacity for 4,120 patients. The buildings for these hospitals were leased from other governments or private owners with one exception. There were also numerous dispensaries furnishing hospitalization at many smaller bases.

Part of the work of the Planning Division, Bureau of Medicine and Surgery, is to consider possible future demands, and, with this in mind, plans have been developed, with the assistance of the Hospital Section, Bureau of Yards and Docks, for the construction and equipment of standard hutment type hospitals when required. These hospitals will be of two types as to construction material and of four types as to capacity. The construction types will be, one of screen wire and canvas, for use in the Tropics, and the other of wood construction, for use in temperate climate. The capacities of the different types are 100, 500, 1,000, and 2,000 patient beds, together with quarters for staff personnel.

During the World War, one of our base hospitals overseas, at Queenstown, Ireland, was an assembly of the "Aladdin" fabricated buildings, each building (unit) 32 feet long by 20 feet wide, sheathed on the outside and paneled on the inside with tongued-and-grooved lumber. The cost of each unit was $508, delivered at the tidewaters of Virginia. Every effort was made to expedite delivery of this material, yet it was three months from the time the order was placed until delivery was made. On arrival at the selected site, after ship transport, many panes of glass in the window panels were broken, and, owing to war-time conditions, procurement for replacement was very difficult. For economy and convenience in handling patients it was necessary to assemble two, three, or four of these units for one building, hence there was a waste of material as the ends of many units were not utilized. Although these buildings are designated as portables, the work of erection requires considerable skill and time; also, there is much destruction in taking them down to remove elsewhere.

In developing plans for the hutment unit it was decided that simple construction with standard stock material was to be desired. This material is usually carried in stock by the Supply Department, or readily procured in the open market, and could be easily cut and fitted on the selected site by men of little experience in construction. Suitable buildings of one or more units can be constructed of this material according to plot plan and detailed construction plan, by men with no more skill than would be required for the erection of the fabricated units, at much less expense and in less time.

Each standard type hutment unit is a building 32 feet long by 20 feet wide, and is to be erected on concrete piers, except in the case of those units to be used as galley or lavatory, which are to have concrete floors, laid on the ground. A bill of material has been prepared showing quantities required for the construction of one, two, three, and four unit buildings. The quantities include 10 per cent allowance for damage in transportation. It is considered that the four-unit building is the more economical and suitable for ward use, as it will accommodate 40 patients very easily, with a maximum of 45, with two rooms partitioned off to be used as quiet rooms (one may be used for dressing room), also a diet kitchen and linen closet.

The framework of the units, both the screen wire and canvas and the wood construction, are practically the same. Instead of windows in those units for tropical use, where mosquito and fly protection is very necessary, the middle thirds of the sides and ends of the building are covered with screen wire, with a canvas awning that may be raised or lowered as a protection against inclement weather. The upper and lower thirds are covered with canvas. Those units to be

used as nurses' quarters or lavatory should have the screen wire and canvas awning over the upper third to afford more privacy. In the unit of wood construction, the same framework can be readily adapted for colder climates by using lumber instead of canvas for the sides and ends, with the required number of windows for light and ventilation. Wall-board sheathing or additional wood paneling, with insulating material between will permit them to be more readily heated.

In the erection of an experimental unit in the Philippines, it having been found that a native product—suali, was less expensive and more durable than canvas, this material was substituted; also, corrugated-iron roofing was substituted for the prepared roofing as listed in the bill of material. This substitution in the roofing effects a saving in the lumber for sheathing but has the disadvantage of being noisy in a rainy climate. The experimental buildings have been in use for some time and are standing up well against the tropical sun, wind, and rain. They have proved to be very satisfactory. Tentage has the advantage of quick erection, but canvas deteriorates rapidly in the Tropics, and it is not possible to obtain the same comfort for patients that is found in a building with a roof.

Wall board or wood are used for partitions where necessary, and, wherever possible, curtains of colored burlap, preferably green, may be used instead of inside doors except for places which it is necessary to secure.

As this construction is semipermanent and not portable, it is considered that care should be given to the construction and preservation. To give greater life to the canvas, as well as the wood and metal fittings, painting is of great value. The following is suggested:

Exterior—dark green oil paint.

Interior—light green oil paint on walls of wards and quarters, with white oil paint overhead. Lavatories to be painted with white oil paint; also operating and dressing rooms, which should then be enameled.

When prepared roofing is used, a coating of tar and gravel will give better fire protection and longer life.

For the assembly of these units in the construction of a hospital of the desired capacity, plot plans are furnished of an acceptable lay-out based on the principle of concentrating the different activities and permitting ready accessibility for administrative purposes. Communicating "covered runways," as provided in plans, have been reduced to a minimum, for economy of material at a time when procurement is difficult.

It is not intended that these plot plans be rigidly followed; they are diagrammatic and represent an arrangement arrived at after con-

siderable deliberation as to requirements. They will give some information as to the required acreage of site. The local problem may demand quite a different arrangement, as well as different arrangement of partitions within the buildings, location and size of doors, etc.

In all probability, these hospitals will, when required, be established at a naval station, or near by, where public utilities such as potable water supply, electric current, sewers, etc., will be available; if not, provisions should be made in local plans to procure the necessary equipment to furnish these utilities—water purification unit, portable electric generators, water tank, power pumps, piping, etc.

Lists of equipment have been prepared as a guide in fitting out these hospitals. It is believed that all essential items have been included, though local conditions may necessitate some changes. In preparing these lists, special consideration was given to the selection of items readily procured, the elimination of bulky and elaborate equipment when a more simple or portable type may meet requirements, in order to reduce transportation. Instead of the usual type hospital bed, the hospital cot is listed. This cot, with folding head and footpiece, has practically the same dimensions as the hospital bed but is somewhat lighter in weight and less bulky when packed. The "Liberty" folding steel cot is listed for use of enlisted staff personnel. This cot, though of greater bulk and weight than the folding canvas cot, is much more durable and comfortable and its use is warranted. The heavy and bulky surgical and fracture beds are considered essential, but only a minimum number of these beds are listed. The usual type bedside locker is not listed, for it is considered that a folding bedside table of wood or metal will answer the purpose of holding the necessary bedside articles of the patient. A shelf may be secured to the framework of the building, behind the bed, to hold the patient's clothing that must be kept in the ward. This same arrangement is provided for staff quarters, and for officers, nurses, and chief petty officers. A cretonne material is listed for use as a draped curtain from this shelf, under which the clothing may be hung. This arrangement obviates the necessity for the bulky and expensive wardrobes, chiffoniers, etc., that also present a problem in procurement and transportation, and effects a saving in the space of quarters. This arrangement proved satisfactory at the United States Navy Base Hospital No. 4 (hutment type) during the World War.

It will be noted that certain items of equipment listed, such as tables, lockers, cupboards, etc., are designated as items to be made on the premises, and this principle may also be applied to other items if practicable. It must be kept in mind that the most difficult problem in the establishment of the hospital, and one likely to be urgent, is to procure and assemble the material at the hospital site, the accomplishment of which concerns so many agents over whom

the officer charged with the establishment of the hospital has no control.

Lists of supplies (expendable items) have been prepared and the quantities stated are estimated to last for a period of six months in accordance with the average rate of use by hospitals in the case of those items for which this rate is known. It is considered that quantities are adequate to last until additional supplies could be procured to meet the local rate of use, which may be different from the average rate of use because of local conditions, therapeutic preference of medical officers, etc.

Staff personnel allowances for these type hospitals have been prepared, showing rank or rating of officers, nurses, Hospital Corps men, and service corps men. It is assumed that when the necessity for the establishment of the hospital becomes apparent, personnel of the Naval Reserve will be available for this duty. For the administration of hospital and instruction of Naval Reserve personnel, a certain number of regular Navy personnel will be required for key positions. At this time, groups of associated specialists, consisting of surgeon, internist, urologist, clinical pathologist, Röntgenologist, and ophthalmo-oto-laryngologist, are being organized and appointed in the Naval Reserve for this special service in time of a national emergency. The additional personnel will be furnished from general detail. The service corps personnel will consist of the various ratings of the clerical, artificer, commissary, and seaman branches of the regular Navy and Naval Reserve.

The standard type hutment unit is not only suitable for emergency base and station hospitals, but for the temporary expansion of any activity when such type construction will meet the needs. This construction is comparatively low in cost, affords suitable quarters for personnel, comfortable accommodations for the sick, and can be quickly erected by inexperienced personnel.

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## THE SURGICAL CASE[1]

By W. H. Michael, Lieutenant Commander, Medical Corps, United States Navy

The case which comes to the hospital as a surgical case is usually admitted with the handicap of a ready-made diagnosis. There is a hernia to be cured, a tumor to be removed, a gall bladder to be drained, or some other fairly evident carpenter work to be done. The majority of these cases undergo their operation and, without accident, return in due time to the routine of their life. However, a few terminate their hospitalization by leading their funeral procession, simply because their physical condition, other than their

[1] Read, in French, before the Haitian Medical Society, Oct. 12, 1927.

surgical diagnosis, had not been thoroughly studied. It is for the sake of these, who would have been saved if there had been less neglect on the part of the doctor, that I especially wish to speak.

A robust-looking man, anxious to lose as little time as possible, asks to have a hernia which he has had for 20 years removed. He is operated upon the day after admission to the hospital without awaiting the laboratory reports. A few days after, to the confusion and embarrassment of the surgeon, the patient dies of uremia.

Let me give another case. This was a woman 60 years old who had a cystocele which she had had for years. She gave the symptoms of menopause which our enthusiastic gynecologist attributed to her cystocele and advised operation. Fortunately, an interne discovered in time that the patient had an arterial pressure of 240 millimeters. Instead of leaving the hospital as a corpse, which would have been the probable sole result of her operation, she returned to her home with her health much improved by purely medical treatment.

Now, how are we to avoid these accidents? A great doctor said: "Treat the patient and not the disease." In that edict lies the solution of the problem. To treat the patient we must know his condition exactly and in detail before we undertake an operation. We must remember that a hernia, for example, excludes neither syphilis, nor tuberculosis, nor arterial sclerosis, nor heart disease, nor nephritis.

In the first place, we must have an exact and correct history, and make a complete physical examination. The history must reveal any symptom of defect in the respiratory system, nervous system, circulatory system, and genito-urinary system, or any systemic disease, which defect or disease may cause an accident in surgical operations. The physical examination should cover systematically the entire body, but especial attention should be paid to any point brought out by the history.

There are many methods of writing histories and doing physical examinations. They are all good if they cover every detail. Errors creep in generally from neglect in following the method, and not from faults in a well-thought-out method. For some months we have followed at the Haitian General Hospital the method in use at the Massachusetts General Hospital. Naturally, we have made some changes due to the radical difference in our patients as compared with those of the Boston institution.

The third precaution, after the history and the physical examination, is the laboratory work. At the Haitian General Hospital every patient has the following minimum laboratory work:

1. Microscopic and chemical examination of the urine.
2. Examination of the stools for parasites and ova.
3. Examination of the blood for syphilis, malaria, and the percentage of hemoglobin.

Additional work is ordered whenever warranted, but it is only in those desperate cases where minutes count that this minimum laboratory work is neglected.

Now, with all the above material from the clinic and the laboratory at hand, a clear idea of the condition of the patients, and the seriousness of the proposed operation, we should divide all our cases into three classes:

1. The group in good condition, where the risk of operation is negligible. These may undergo the operation without special precautions.
2. The inoperable group, where the risk outweighs the advantages of operation. These, we do our best to relieve by purely medical treatment.
3. The large group of cases which necessitates special care.

It is this third group of cases, in which we have found certain defects, and who might easily be killed by a severe operation or a faulty anesthesia, to which we should give our special attention. The defects which we find most commonly are syphilis, anemia, nephritis, pulmonary disease, heart lesions, and acute febrile diseases.

Fear is a bad symptom and it is preferable to postpone operation when fear is excessive.

The management of these cases necessitates two procedures:

1. Improve the condition of the patient so that he may more safely undergo the operation.
2. Render the operation as harmless as possible.

If symptoms of syphilis are present, the patient should be treated until they disappear. If there are no symptoms of that disease, but a positive serum reaction, it is advisable to administer two doses of neosalvarsan before operation. This is a precaution equally valuable to the operator as to the operated.

The danger from anemia is in proportion to its severity and the extent of the proposed operation. For average major operations it is well to fix 70 per cent as the danger point. Even when at 70 per cent, we should be prepared to carry out special precautions to counteract shock. If possible, more extensive anemia should be treated medically. However, if the anemia is due to malignant disease, or medical treatment can not be continued with success, it may be necessary to resort to transfusion before and even during operation.

In kidney disease the functional test should be carried out with phenolsulphonephthalein, and every effort possible made to raise the percentage of excretion to 40 or above.

Acute pulmonary disease should be treated before operation. Cases of chronic disease should be operated upon between attacks. Ether anesthesia should, if possible, be avoided in these cases.

The condition of cases of valvular heart disease can usually be improved before operation by intensive treatment.

Acute febrile disease contraindicates all operations except the desperate cases.

With each treated and his condition improved, how can we reduce the danger of the operation? We have many methods.

In those cases where the condition is doubtful the intravenous injection of glucose-insulin solution before operation reduces acidosis and the risk of shock.

Spinal anesthesia can often be substituted for ether in operations of an hour or less in duration which are to be done below the level of the umbilicus. This method practically eliminates shock and is especially recommended in genito-urinary operations.

Anesthesia by nitrous oxide produces less shock than ether. It is valuable in short operations where relaxation of the muscles is not essential.

Local and regional anesthesia can often be substituted for general anesthesia with the marked advantage of reducing shock to a minimum.

If a general anesthetic is to be used it should be given by an expert.

Traumatism should be avoided during operation, and the patient should be kept warm.

Saline under the skin, glucose-insulin intravenously, transfusion, or hypodermics of strychnine, adrenalin, or caffein may be resorted to during the operation.

Protoclysis after operation reduces discomfort and thirst, but its results are not comparable to the intravenous injection of glucose-insulin solution.

I wish to emphasize that these special precautions should be begun at the slightest sign of danger, and we should not wait until the condition of the patient becomes desperate.

To conclude my talk let me formulate a good rule. We should only undertake an operation when we can assure our patients that in our hands their condition in all probability will be improved, and that the danger they run in undergoing an operation is not out of proportion to the improvement expected.

If we can not give them this assurance we must not operate.

# CLINICAL NOTES

## A METHOD FOR COMPLETE DILATATION OF CICATRICIAL STENOSIS OF THE ESOPHAGUS

By C. M. Shaar, Lieutenant, Medical Corps, United States Navy

The purpose of this paper is not to recommend a novel method for the cure of all cicatricial stenoses of the esophagus. It is to report a method which has given most satisfactory results in a case of cicatricial stenosis of the esophagus due to accidental swallowing of lye.

### History of Case

J. E. H., American sailor, age 23 years, admitted December 8, 1925, to the United States naval hospital, Boston, Mass., because of aphagia of two days' duration.

On February 17, 1923, while aboard ship, he drank from a copper kettle containing coffee to which lye and soap were added for washing purposes. There was immediate dysphagia, burning in tongue and throat, vomiting, and distress. He was transferred to the hospital immediately and treated until his symptoms subsided. Since that time he had been having difficulty in swallowing food which was not well masticated. He also complained of regurgitation, distress after eating, and loss of 19 pounds of weight. Two days prior to present admission (December 6, 1925), while eating peanut brittle candy, he suddenly was unable to swallow. This he attributed to a piece of peanut sticking down his throat. Since then he has been suffering from dysphagia and regurgitating mucus.

Physical examination shows marked emaciation. Patient's weight, 119 pounds. Except for marked emaciation patient's physical examination did not show any abnormality.

Röntgen-ray examination showed definite obstruction of the esophagus on a level with the intervertebral disc of the sixth and seventh thoracic vertebrae.

### Treatment

Bouginage was instituted to dilate the stricture. Further examination revealed another less extensive stricture above the diaphragm. Dilatation of the strictures was gradual, and on March 15, 1926, a

bougie, size 36 French, was passed with reasonable ease. Patient's condition became satisfactory. High caloric diet, mainly soft and liquid food, resulted in 16 pounds increase in body weight, but the patient continued to complain of difficulty in swallowing meat even when it was well masticated. At this period the problem presented itself from a different angle. The man could not be returned to duty unless he was able to eat the food given a sailor aboard ship, and a medical discharge would have meant a loss of a man and expense to the Government. For further dilatation of the stricture the apparatus which will be described was made and used successfully.

A stomach tube was tied at its distal end so as to prevent the escape of the opaque liquid through that opening. A small fenestration was made in the stomach tube about 6 inches from the tied extremity. A condom, from which the blind end was removed, was telescoped over the stomach tube and tied with fine braided silk above and below the fenestration.

The rubber funnel was removed from the stomach tube and replaced with a large metal syringe containing a barium sulphate solution. Through this arrangement gradual dilatation of the condom could be made by slowly injecting the barium through the proximal end of the stomach tube. The condom was selected for this purpose as it was thought such thin rubber would be less likely to rupture a stricture and yet it yields readily to dilatation. Occasionally it was found necessary to use two condoms for additional strength. Full dilatation of the cicatricial stenosis was accomplished by means of the above-described apparatus and with the aid of the fluoroscope. The patient was placed in front of the Röntgenoscopic tube at an angle of about 45°, so that his left scapula was directed toward the tube while the screen was placed over his right chest, the patient being rotated slightly in either direction until the greatest space was obtained between the shadow of the vertebral column behind and that of the heart and aorta in front. This procedure proved most satisfactory in observing the course of the tube. An aqueous solution of barium sulphate was then injected through the stomach tube by means of a syringe. The quantity injected was sufficient to visualize the tube when introduced into the esophagus but not sufficient to dilate the condom. The stomach tube was introduced until the outline of the condom was visualized in the stricture. The tube was held in that position and the aqueous solution of barium sulphate in the syringe was injected slowly, which dilated the condom, thereby dilating the stricture.

The patient was instructed to raise his hand whenever the pain or discomfort became unbearable. At this signal the pressure was relieved immediately by drawing some of the solution back into the

FIG. 1.—LATERAL VIEW

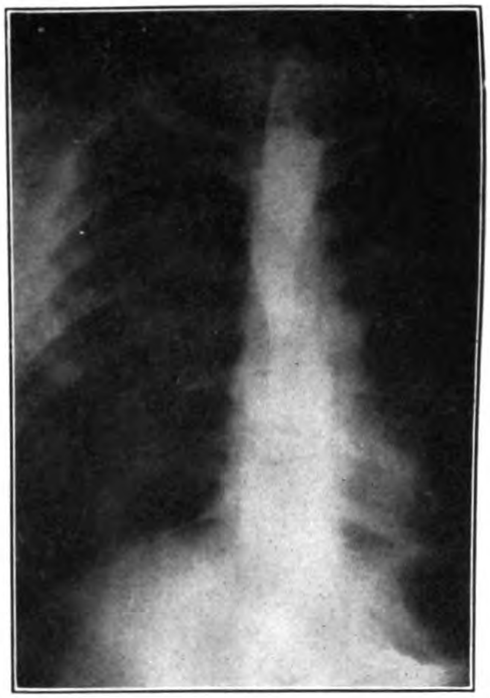

FIG. 2.—ANTERO-POSTERIOR VIEW

Roentgenograms of chest showing stricture of the esophagus of 2 years and 11 months duration. Barium solution not passing beyond stricture

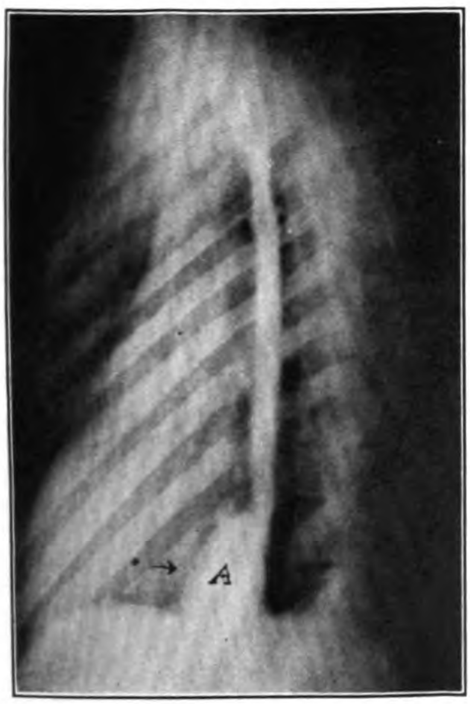


FIG. 3.—ROENTGENOGRAM SHOWING THE ESOPHAGUS WITH THE APPARATUS DILATING THE LOWER STRICTURE

A. Condom dilated with barium

FIG. 4.—ROENTGENOGRAM SHOWING CONDOM AFTER PASSING UPPER STRICTURE


FIG. 5.—PHOTOGRAPH OF THE APPARATUS USED FOR COMPLETE DILATATION OF STRICTURE

A. Syringe containing solution of barium sulphate
B. Condom dilated with the solution through an opening made through the stomach tube; condom is tied above and below the opening. End of stomach tube is tied

FIG. 6.—ROENTGENOGRAM SHOWING THE UPPER STRICTURE BEFORE TREATMENT

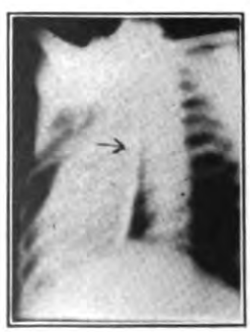

FIG. 7.—ROENTGENOGRAM SHOWING ESOPHAGUS AFTER COMPLETE DILATATION OF STRICTURE. AFTER THE PATIENT HAD SWALLOWED A SMALL AMOUNT OF BARIUM THE OUTLINE OF THE ESOPHAGUS WAS EASILY SEEN

syringe. The apparatus was retained in situ as long as the patient was able to tolerate it. This procedure was performed daily for one month. The dilatation was very gradual and the patient was able to tolerate it for longer intervals each day.

On July 23, 1926, patient was returned to duty symptom free. His weight increased from 119 pounds to 144 pounds. General condition very satisfactory.

This procedure should be undertaken with great care and a gentle hand. Full dilatation of the stricture should be carried over a long period of time. Each day the dilatation should be made gradually by forcing a small amount of the fluid. An increase of a few cubic

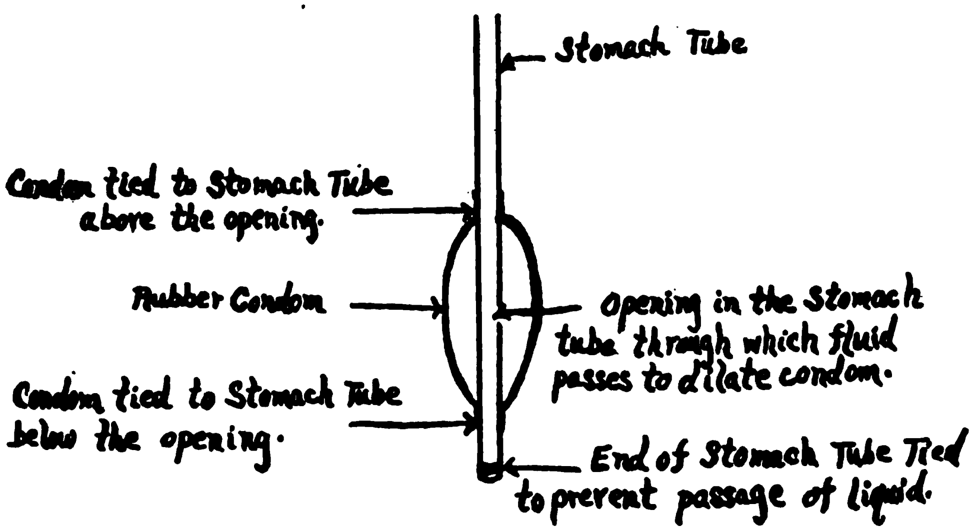


Diagram to illustrate the apparatus.

FIG. 8

centimeters daily should be sufficient. The rapid injection of a large amount of the opaque meal is dangerous, as it may cause rapid divulsion. The mortality in such accidents is very high.

## RESULTS

The patient has been on active duty since his discharge from the hospital, 16 months ago. He has not experienced any difficulty in swallowing solid food and further hospitalization has not been indicated.

## CONCLUSION

Blind methods of dilatation of cicatricial stenosis of the esophagus are dangerous, and the method described above is now being offered

as a substitute. It is a method which will prove of value in certain selected cases to complete what usual bouginage has been unable to accomplish.

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## TONSILLECTOMY

By W. S. SARGENT, Lieutenant, Medical Corps, United States Navy

Waldeyer's ring corresponds to the anterior limit of the foregut and is therefore of entodermal epithelium. The ring consists of the faucial, pharyngeal, and lingual tonsils. The so-called laryngeal, tubal, and nasal tonsils are not often seen. The lingual tonsil rarely gives trouble. Its follicles are not fully developed until 5 years of age and there is a close lymphatic relation to the lingual glands. The pharyngeal tonsil comes from epipharyngeal mucosal folds which become infiltrated with lymphoid cells. These ridges normally disappear by atrophic changes at puberty. When enlarged, adenoids result, which usually block both nostrils. Adenoids are commonest at from 3 to 10 years of age. Space doesn't permit of a discussion of the causes, symptoms, and results of adenoids; suffice it to say that often the faucial tonsil is enlarged, the soft palate relaxed, and the uvula elongated also, and that obstruction to nasal respiration calls for removal of the adenoids.

It is the faucial tonsil that chiefly concerns us in this paper. About the third month of intrauterine life, in the region of the ventral part of the second branchial groove, the entoderm grows into the connective tissue in the form of a hollow bud from which secondary buds, first solid and later hollow, develop. The buds form the crypts of the tonsils, while the connective tissue and the lymph cells derived from the blood vessels or from the epithelium direct form the rest of the organ. The follicles are not completely developed until several months after birth. The supratonsillar fossa is the remains of the sinus tonsillare. The connective tissue forms the capsule, from which trabeculæ penetrate the diffuse and nodular lymphoid tissue. The nodules show germinal centers, and whether the normal tonsil has a protective function or produces lymphocytes is unsettled. Up to 8 years of age it is thought to be a physiological structure. At any rate, a diseased tonsil has no function and needs treatment. The tonsils are situated so that they are exposed to infection. The epithelium does not uniformly cover the tonsil, its structure lets bacteria enter, bacteria may traverse the tonsil, with or without giving rise to local alterations, and therefore constitutional disease may be the manifestation of infection which is due to the tonsil.

Like other lymphatic tissue, the tonsils are subjects to age variations. Proportionately they are larger in the young. A large tonsil is not

necessarily a diseased tonsil; it may be hyperplastic, in which case it does not contract and there is no retention of infectious material. The soft variety of chronically inflamed tonsil tends toward atrophic changes at puberty, as does the so-called hyperplastic variety of enlarged tonsil. The soft variety is the one in which climate plays such a part in etiology. Venous congestion, stasis or infiltration, and inflammatory changes are responsible for enlargement. The hard variety is apt to be smaller, as inflammatory tissue contracts and there is a certain amount of pressure atrophy. Gout tends to cause a regular and diffuse inflammatory thickening, while repeated inflammation of the tonsil from other causes tends to cause an irregular surface.

A chronically diseased tonsil predisposes to acute attacks and abcess, tonsillar and peritonsillar. A severe infection in the connective tissue may in turn leave the tonsil lobulated, irregular, full of adhesions, and chronically diseased and containing pockets of pent-up secretions due to the adhesions and diseased crypts. A small deep-seated focus may give rise to continued fever. A person with chronic tonsillitis is more liable to contract diphtheria, scarlet fever, and other diseases. Acute infectious diseases are often followed by chronic changes. It is well known that chronic constipation and intestinal affections cause engorgement of the upper respiratory mucosa.

The afferent lymphatic vessels to the tonsil come from the adjacent structures and, therefore, inflammation in the nose and throat is prone to affect the tonsil. The afferent vessels go to the cervical lymph nodes, especially of the upper deep cervical group and the submaxillary nodes. The crypts of the tonsil are more numerous in the upper half. Enlargement causes increased depth of the crypts, together with which preexisting inflammation forms the small "pockets"; a calculus may thereby form in the tonsil. Peritonsillar pockets are usually the result of adhesions.

There are many predisposing causes of chronic tonsillitis, such as scrofula, malnutrition, lues, tuberculosis, rheumatism, indigestion, colds, scarlet fever, diphtheria, measles, whooping cough, quinsy, repeated acute attacks, gout, uric acid diathesis, and lymphatic tendencies. In turn, chronic tonsillitis has been known to cause chorea, epilepsy, persistent cough, rheumatic fever, heart affections, eneuresis, spondylitis, insomnia, nightmare, cervical adenitis, and others; and in these conditions, where there is chronic tonsillar pathology present, a tonsillectomy should be done, especially if there are not other ascertainable probable causative factors.

The primary indications for tonsillectomy are diseased, chronically infected tonsils, or tonsils which by size or position are interfering

with some normal bodily function. The object of tonsillectomy is to remove foci or restore some abnormal function caused by the tonsils. A tonsil should be removed if it is obstructive. It may, by its size, interfere with phonation or deglutition. A patient with large tonsils frequently complains of discomfort in the throat. The sense of smell and taste are often altered and speech may be affected, a person's articulation being poor. Pressure may block nasal respiration. Since chronic inflammation is so prone to follow acute inflammation, it is necessary to ascertain if the patient is subject to repeated attacks of acute tonsillitis or frequent colds. A history of tonsillar or peritonsillar abscess calls for tonsillectomy, as it leaves adhesions and, in turn, pent-up secretions or pus. A tonsil that fails to atrophy at puberty is not normal and is a potential source of trouble and is usually diseased. Either because of adhesions or associated inflammation the uvula moves poorly, and the palate and pillars are affected when the tonsils are diseased. By pressure upon, or extension of inflammation into, the Eustachian tube, ear trouble may result, with subsequent affection of hearing. Mouth breathing is more common from enlarged tonsils than we are apt to think; a nasal twang to the voice is often an accompanying symptom. An enlarged tonsil is rarely congenital. It is well when a case of chronic tonsillitis is seen to determine if it is a local condition or part of a systemic disease. Deep crypts in themselves are an indication for tonsillectomy, as they are practically always diseased. A tonsillectomy was done recently on a woman who frequently, by pressure with the finger on the tonsils, would squeeze out numerous pieces of caseous material. It will be interesting to see if the tonsillectomy has any beneficial effect on a recently developed epilepsy minor. The case showed that there was considerable caseous material and pus hidden in pockets that did not open on the surface.

In diseased tonsils the anterior pillar of the fauces is usually red, and injected vessels are plainly seen. The tonsil has small glands around its periphery which are apt to become involved and show as small "pimples" there and on the anterior pillar; even the soft palate may have enlarged glands and the veins of the pharynx stand out prominently. Very often follicles of pent-up pus can be seen under the mucous membrane of the tonsil; and white striæ seen on the tonsils usually mean past inflammation, evidences of which may be felt with the finger. An embedded tonsil lying high up should be removed because it is apt to cause pressure which interferes with nasal respiration or ventilation of the middle ear. If a partly submerged tonsil is adherent to the pillars, surgery is to be recommended. Recurrent adenoids are often accompanied by chronic tonsillitis. Recurrent attacks of diphtheria or Vincent's angina call

for tonsillectomy, as do tumors, benign or malignant. Lues and tuberculosis of the tonsil must receive general treatment, but, upon improvement or cure, tonsillectomy is to be considered. If a chronically diseased tonsil is not removed, a patient is subject to the complications of recurrent acute attacks. Gangrene, mycosis, and actinomycosis are rarely seen, but chronic inflammation is a predisposing factor in these conditions. An unsuspected chronic abscess is frequently seen in doing a tonsillectomy. A foreign body that can not be removed otherwise demands tonsillectomy, as it is apt to cause abscess formation.

Before doing a tonsillectomy a careful physical examination, including an urinalysis and a test for coagulation time, is to be made. Hemophilia is rare and jaundice easily seen, but care is needed to avoid operating on patients with either. Children, most women, and all nervous individuals, if there are no bodily contraindications, are best operated upon with general anesthesia, yet where the patient will probably stand the local anesthesia it is to be preferred on account of the complications of general anesthesia, chief among which are pneumonia and lung abscess. Any case of enlarged tonsil may be accompanied by status lymphaticus, and local as well as general anesthesia is dangerous in these cases, some of which can be discovered by percussion of the chest in the physical examination.

An operation should be done in a hospital if possible. If not, it is better to do it in the home, as taking a patient out of the office into the air and dust exposes him to the dangers of infection and hemorrhage. The tonsil should be felt with the finger, as this gives an idea of its consistency and the type of disease one has to deal with, and if a large anomalous artery be present it might be detected. The nerve fibers which supply the tonsils come from the sphenopalatine ganglion and the glossopharyngeal nerves. In using local anesthesia to block sensation a 1 per cent sterile procaine solution which contains 15 or 20 drops of adrenalin to the ounce is injected through the anterior pillar and behind the tonsil, endeavor being made to distribute it in the tissue between the tonsil and the pharyngeal constrictor. The tissue is infiltrated well up and well down back of the tonsil, and a few drops are placed in the posterior pillar. The old punch operation, tonsillotomy, and the thermo-cautery method are not often used now, while the finger enucleation is done by a few. The Sluder method, in the writer's opinion, removes the tonsil too fast, and there is more bleeding as a result. Dissection and the use of the snare is the operation of choice, and among the various methods, that of Lott, of Jefferson Medical College of Philadelphia, is preferred to the U or V shaped incision of Kyle or Davis, or other methods.

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In this method Lott has perfected a tonsil everter which has a dull blade curved upward on one end and a dull blade curved upward and outward on the other. The tonsil is grasped with tenaculum forceps, avoiding the pillars entirely, well up and well down, and traction made medialward. The tonsil can be pulled out, due to the imperfect capsule and the connective tissue attachment to the aponeurosis, and when an incision is made in the mucosa the tonsil will turn out. In this method the plica triangularis, which is the only remains of the old tuberculum tonsillare, is torn from the tonsil, care being used not to touch the anterior pillar, so as to leave it intact and not interfere with its blood supply. It is also important not to cut into the tonsil with this tearing, as it may leave a piece of tonsil back of the anterior pillar when the snare cuts the tonsil out. The anterior tonsillar fossa is under this plica and often contains pent-up pus or caseous material. When the plica triangularis is separated as above, the tonsil comes still more toward the midline upon traction. Then the most curved end of the Lott everter is thrust into the upper pole of the tonsil, under the supratonsillar fossa, and by a movement of the curve downward and medially the tonsil everts and the upper grasp of the tenaculum forceps is let go (still holding the lower) and reapplied to the upper pole of the tonsil. The snare is now applied and the cutting edge is kept parallel to the lateral pharyngeal wall. A very important point here is to screw the snare up very slowly, because by doing so the vessels are crushed and twisted instead of cut squarely across, and there will be less bleeding.

After the tonsils are both out they are examined to see if any piece has been left; if the operator has dropped both tonsils and doesn't know upon which side a piece might have been left (seeing from one of them that a piece has been left) he can usually tell the side by the fact that the posterior border is the thicker. There is always a small piece of tissue below the area from which the tonsil has been removed and continuous with the lymphoid tissue at the base of the tongue. This, I always go back after and remove, because later it may enlarge and fill the lower end of the fossa and give the appearance of a piece of tonsil having been left. Unfortunately there are doctors who, seeing the patient later, maliciously or through lack of knowledge tell him that the doctor who did the operation did a poor job and left a piece in.

A patient should not leave the operating room until all hemorrhage has been stopped. He is then put to bed on his side, told not to "hawk" or clear his throat and to swallow as little as possible: an ice collar is applied to his throat and he is given a quarter of a grain of morphine, hypodermically, as there is considerable pain as

the local anæsthesia wears off. No other local treatment is given. If the upper pole has been completely removed there is little danger of abscess.

For the first 18 hours, hemorrhage is more apt to occur, and during that time nothing should be given by mouth. When bleeding occurs it is usually in adults and in those upon whom a rapid removal has been done. A large vein is sometimes seen in the fossa after tonsillectomy and may be a source of bleeding; it communicates with the lingual and pharyngeal plexus. There is occasionally bleeding from an enlarged artery in the anterior pillar, a vessel derived from the dorsalis linguæ and called the anterior tonsillar. The posterior tonsillar artery, from the ascending pharyngeal, and the superior tonsillar artery, from the descending palatine of the internal maxillary, are the ones most frequently concerned in hemorrhage. The external maxillary gives two branches, an anterior, or tonsillar, and a posterior, or ascending palatine, which rarely cause hemorrhage. The small meningeal is supposed to send a twig to the tonsil. The internal carotid, ascending pharyngeal, and ascending palatine arteries are normally well to the outside of the tonsil, but they may be anomalously placed and the external maxillary and the lingual may be high up in position. When primary hemorrhage occurs it is usually stopped by pressure, astringents, clamps, or ligation of the bleeding point, preferably the later. It is extremely rare to need horse serum, transfusion, or ligation of the common carotid. Secondary hemorrhage, which happens about the fifth to seventh day, if it occurs, is stopped by pressure and astringents as a rule; ligatures usually will not hold in this granulation tissue.

The anterior pillar may atrophy after tonsillectomy even if not injured at operation. This is due to interference with its blood supply from the dorsalis linguæ. Earache, while it may be due to otitis media, is usually referred from the throat. The uvula should not have been injured and the palate and pillars should have been untouched. The motion of the pillars and pharyngeal wall should be improved. The general health is often better, a bad breath is frequently cleared up, and eneuresis occasionally is stopped.

### Summary and Conclusions

1. The anterior pillar is from the second, and the posterior pillar from the third, branchial arch. The tonsil is derived from the second inner branchial groove. The supratonsillar fossa is the remains of the sinus tonsillare, while the plica triangularis is the only remains of the tuberculum tonsillare.

2. Up to 8 years of age the tonsil is thought to be a physiological structure. But a diseased tonsil at any age has lost its function and is a menace.

3. The afferent tonsillar lymph vessels coming from contiguous structures explain the frequent association of tonsillar and nose and throat affections, while the efferent vessels go to the upper deep cervical and submaxillary nodes, mainly. A few months ago I treated a woman who had developed an acute unilateral cryptic tonsillitis (superimposed upon chronic tonsillitis) and as recovery was ensuing the deep upper cervical nodes suppurated on that side necessitating incision and drainage.

4. The two fundamental indications for tonsillectomy are: (1) Interference by the tonsil with some normal body function and (2) chronically affected tonsils. The object sought is to restore the altered function or to remove foci.

Everyone doing tonsillectomies should be well versed in all the details which determine whether a tonsil should be removed or not. Before considering the disease in the tonsil per se we must ascertain if the tonsil is responsible for:

(*a*) Repeated acute attacks or abscess (tonsillar or peritonsillar).
(*b*) Obstruction.
(*c*) Interference with phonation, speech, articulation, deglutition.
(*d*) Discomfort in the throat.
(*e*) Any interference with smell or taste.
(*f*) A nasal twang to the voice.
(*g*) Failure to atrophy at puberty.
(*h*) Poor or altered movement of the uvula, pillars, palate, or pharyngeal wall.
(*i*) Any local or systemic pathology.
(*j*) Mouth breathing or interference with nasal breathing.
(*k*) Middle-ear disease, acute or chronic, as result of inflammation or pressure from embedded tonsils lying high up.
(*l*) Recurrent colds or recurrent adenoids.
(*m*) Recurrent diphtheria or recurrent Vincent's angina.

If the tonsils are responsible for any of the above, tonsillectomy is indicated.

To tell whether a tonsil is diseased and should be removed because of the local pathology, the presence of the following signs, one or more of which will always be present if the tonsil is diseased, is relied upon:

(A) Palpation.

(1) Presence of soft area suggesting chronic abscess.
(2) Hard, firm, fibrous tonsil.

(B) Inspection.

(1) Red, injected anterior pillar.

(2) "Pimples" on anterior pillar or around periphery of tonsil.

(3) Deep crypts.

(4) Adhesions within itself or to adjacent structures.

(5) Pus or caseous material that can be squeezed out.

(6) Interfered movement of uvula, palate, pillars, or pharynx wall.

(7) Scars or striæ of fibrous tissue on tonsil or pillars.

(8) Follicles containing detritus under mucosa of tonsil.

(9) Enlarged glands in soft palate.

(10) Enlarged adjacent veins of pharynx.

(11) Calculus or amygdolith.

(12) Submerged tonsils.

(13) Excessively enlarged tonsils.

(C) Sense of smell.

(1) Bad breath from mouth but not from nose, if the teeth are normal.

5. Status lymphaticus and hemophilia are always to be kept in mind.

6. Children, many women, and nervous people should receive general anethesia; others may have local.

7. A patient should not be taken out of doors on the day of operation on account of danger of hemorrhage and infection.

8. Lott's method of removal is very efficient; it does not touch the anterior or posterior pillars and there is very little bleeding. Of about 500 tonsillectomies (nearly one-half of which have been performed on children) I have had only 2 cases of hemorrhage within the first 24 hours and 4 cases of slight secondary hemorrhage, and I believe the slow application of the snare wire is a big factor in occluding the vessels. It probably crushes and twists the vessels and curls the intima.

9. For later appearances it is well always to go back and get the tags at the lower end of the fossa and base of the tongue.

10. As the local anesthetic wears off there is a great deal of pain and morphine should be given; it will also help to keep the patient quiet.

11. The patient should be put on his side with the head directed downward in order to detect the first sign of hemorrhage.

12. A test of coagulation time should be made on every patient, and no operation should be done on anyone having a coagulation time of more than six minutes.

# SODIUM THIOSULPHATE IN THE TREATMENT OF SYPHILIS[1]

By J. W. Kimbrough, Lieutenant (Junior Grade), Medical Corps, United States Navy

Since the early and much-disputed origin of syphilis this disease has come to occupy an increasingly prominent place in medical literature. This has come about largely as a result of increasing knowledge concerning the complexities of the manifestations and treatment of this condition.

Concerning the early treatment the Spanish physician, Diaz de Isla, who treated syphilitic members of Columbus's crew at the Hospital of All Saints, in Lisbon, about 1493, states that at the time of Columbus's arrival in the West Indies the Indians already possessed a highly complicated and rationally developed method for treating the ailment. This consisted chiefly of guaiacum and other vegetable beverages in combination with dietetics and climatic methods of treatment.

From this primitive treatment to the salvarsan and neosalvarsan of the present day has stretched an interval which has seen the introduction of mercury, arsenic, and the iodides—the bedrock upon which modern antileutic therapy is founded. The results, however, were disappointing, due to the fact that, while the arsenic and mercury both possessed a certain destructive action on the causative organism, the quantity that could be given was limited, owing to its poisonous action on the patient. Also the inorganic arsenic, the form first used, proved to have little specific affinity for the parasite, while it was very poisonous to the tissues of the host. In other words, it was more strongly organotropic than parasitotropic. Further experimentation developed organic preparations of arsenic, the first of which was atoxyl or sodium arsanilate.

It was soon pointed out by Ehrlich that this preparation had practically no parasitic action in test-tube experiments, and only gained this property in the tissues. He explained this by the view that the pentavalent arsenic compounds, such as atoxyl, acquire activity only upon being changed to the trivalent arsenic, such as exists in arsenites. This led him to seek for trivalent compounds of organic arsenic, and, as a result, arsenophenylglycin and salvarsan were introduced. More recently, neosalvarsan, a modification of the parent substance salvarsan, has come into use. All of these organic compounds of arsenic are much less poisonous to men and the higher animals than the inorganic form, but, at the same time, the poisonous action toward the protozoa that infect the bood and tissues is maintained. The theory advanced by Ehrlich to explain this selective action supposes that certain parts of the molecule in these com-

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pounds attach themselves to the parasites, and that these haptophoric groups then allow the poisonous part, or toxophoric groups, to act on the protozoa. In the case of man and the higher animals the tissues do not afford points of attachment for the haptophoric groups and therefore are not attacked by the toxophoric radical. Another view is that the organic compounds readily permeate into the parasite and are there decomposed, possibly to inorganic arsenic, and thus prove poisonous to the protozoa; the mammalian cell is permeated less readily and thus escapes destruction.

Salvarsan injected intravenously appears unchanged in the urine in 5 to 10 minutes and in this form persists for 5 to 6 hours; thereafter arsenic is found in the urine for some days, apparently in the form of arsenites and arsenates. The stools contain arsenic in smaller proportion than the urine, but for a longer time. It disappears from the blood at about the same time as from the excretions, but may be found rather later in the bone marrow, liver, and kidneys. However no arsenic is to be found in any of the organs after 15 days. Arsenic corresponding to 50 to 75 per cent of that injected has been regained from the excretions; the fate of the remaining 25 per cent is unknown.

The excretion of neosalvarsan differs from that of salvarsan only in the fact that formaldehyde appears in the urine for a few hours, due to the decomposition of the molecule.

In practice, the arsenic preparations have proved to be of less value than the first applications seemed to promise, owing to the organisms rapidly becoming tolerant to the drug. Experimentally, the descendants of the resistant type maintain their tolerance through an indefinite number of generations, so that theoretically a time may come when the arsenic preparations will progressively decrease in efficiency.

This tolerance on the part of the invading organism has given rise to the very troublesome Wassermann-fast reaction, which has been defined by Schamberg as "A reaction that remains strongly positive or uninfluenced by long-continued treatment which is able in most cases to reverse a positive Wassermann." To enumerate all the theories advanced to explain this condition would be boresome, but some of the causes are said to be the following:

(1) Failure in early diagnosis.
(2) Lack of intelligent treatment.
(3) Congenital syphilis.
(4) Cardiovascular syphilis.
(5) Pulmonary syphilis.
(6) Late mucous membrane lesions associated with or mistaken for malignancy.

(7) Nervous system syphilis.
(8) Osseous syphilis.
(9) A recently recognized group, called asymptomatic syphilis, which can not be placed in any of the above groupings.
(10) Alcoholic abuse by syphilitic patients.

It appears that no one who has had experience in the treatment of syphilis believes that a patient with a positive Wassermann reaction is cured. The management of the Wassermann-fast case requires individualized rather than routine treatment.

Many different substances have been introduced into antiluetic therapy for use in cases where the usual treatment has not proved successful. Among these is sodium thiosulphate.

Sodium thiosulphate is a salt obtained by the addition of sulphur to a solution of sodium sulphite. It is also prepared from the calcium sulphide obtained as a by-product in the manufacture of sodium carbonate. It is very soluble in water, in which it readily forms supersaturated solutions. Acids react with it with the liberation of free sulphur. Dilute solutions undergo a similar change when exposed to the air, due to the action of carbonic acid. With free iodine, a reaction takes place resulting in the formation of sodium iodide and sodium tetrathionate. Sodium thiosulphate is used extensively in photography as a solvent for silver salts.

The Wassermann-fast condition is explained by the fact that the spirochetes become tolerant to the drug being used. Also mercury, arsenic, and other metals may be changed in the system into albuminoids, and these in turn may be incorporated into and become integral parts of the body cells. For example, the calcium which occurs as a phosphate in all cells may be displaced in a damaged and weakened cell by an albuminous metal and thus interfere with the function of the cell. Countless numbers of cells of the brain, liver, spinal cord, and heart being thus affected, the health of the patient will naturally suffer proportionately. Indeed it is not too much to assume that this is exactly what happens to a large part of the arsenic used when we recall that the fate of one-fourth of the arsenic injected into the body is unknown. The progressively increasing pallor and malnutrition of the overtreated patient is familiar to all.

Having three extremely resistant cases of this type under treatment, all of whom gave histories of having received repeated courses of antiluetic treatment, the use of sodium thiosulphate was decided upon. Triple distilled water containing 1 gram of sodium thiosulphate to 10 cubic centimeters of solution was used, and intravenous injections of one-half gram (5 cubic centimeters) were given twice

weekly for two weeks. There were no reactions. Following the first injection, improvement in the condition of the patient was noted. This consisted of a gain in body weight, better color and appetite, and the patient's statement that he felt better. As an example, one patient lost 3 pounds during the last week of neoarsphenamine therapy and this same man gained one-half pound following his first injection of sodium thiosulphate. At the end of the course the patients showed very noticeable improvement, but the blood Wassermann remained positive. Neoarsphenamine in small doses was then resumed and after two to four injections the Wassermann reaction, which had previously remained persistently positive despite prolonged neoarsphenamine therapy, unexpectedly became negative. This interesting result in these advanced cases led to further experimentation in cases representing different stages of the disease. Patients with chancres and positive Wassermanns were given six intravenous injections of neosalvarsan. These consisted of three or four injections of four-tenths of a gram and two or three of six-tenths until the total of six injections was reached. In no instance did the dosage exceed six-tenths of a gram and no reactions were noted. Following the sixth injection of neoarsphenamine the Wassermann was positive. Without any interruption, the sodium thiosulphate was begun and carried through as above. The patients were weighed weekly, as it was constantly borne in mind that an individual was being treated and not a serologic reaction. Following the first injection, a gain in body weight was noted, and the patients spoke of feeling better. This improvement and gain in weight was more noticeable as the sodium thiosulphate course proceeded. Without being questioned as to the time of their first noticing this improvement, some of the men stated that they had begun feeling better after the "first shot of white (colorless) medicine." After the second or third injection of sodium thiosulphate the Wassermann became negative for the first time. At the end of the course there was a tendency for it to become positive again, although some remained negative. The positive reactions varied from 1 to 4 plus. Following one injection of six-tenths of a gram of neosalvarsan the Wassermann again became negative.

The action of sodium thiosulphate is similar to that of salvarsan in that it is entirely theoretical. However, the following modes of action are suggested:

(1) *The tolerance of the spirochetes is destroyed.*—This is due to the fact that sodium thiosulphate, having an action exactly opposite to that of salvarsan, brings about a different tissue reaction that is antagonistic to that caused by the former. This can be shown by the fact that when either salvarsan or neosalvarsan is accidentally injected extravenously, injection of the area with sodium thiosulphate

will prevent the customary intense inflammatory reaction. Also, after the use of sodium thiosulphate neosalvarsan seems to have a much more powerful action.

(2) *The body cells are able to give up their abnormal metallic content which they have incorporated as a result of antiluetic treatment and the metal thus released is available as a therapeutic agent.*—That this is the case is indicated by the fact that the rapid clinical improvement points to an elimination of the more or less mild toxic condition resulting from the antiluetic treatment. That the arsenic, or other metal, thus liberated from the cell is active in combating the invading organisms is shown by the negative Wassermann reaction noted during or after the use of sodium thiosulphate and the tendency for the reappearance of a positive reaction when this reserve is exhausted. Also, it should be remembered that the chief commercial use of sodium thiosulphate is due to the fact that it is a solvent of metallic salts.

Sufficient time has not elapsed for the collection of a great number of cases, but this article is based on approximately a dozen cases, and in none of these was anything noted which did not conform to the above theories. Throughout the treatment of these cases, 5 grains of potassium iodide were given three times a day and inunctions of 1 dram of mercurial ointment were given twice weekly. No reactions were noted at any time. One patient showed albumen and casts after the second injection of sodium thiosulphate, but this cleared up and he received the full course after the omission of only one injection. The clinical improvement noted was not due to overenthusiastic observations, as the patients were weighed weekly. The Wassermann reaction was checked once a week by the laboratory. A negative Wassermann was secured in the early cases by the use of 3.7 grams of neosalvarsan and 2 grams of sodium thiosulphate. Patients having received repeated courses of antiluetic treatment required slightly more neosalvarsan. The cases varied from patients with a chancre to those having marked central nervous system involvement, and in no instance was it found impossible to secure a negative Wassermann. Spinal fluid findings improved progressively along with the clinical condition and blood Wassermann.

It is too early to say definitely what value sodium thiosulphate may have in the treatment of syphilis. However, it seems to offer maximum results from a minimum amount of salvarsan, the active principle of which, arsenic, is toxic to the human organism.

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## ACUTE LYMPHOBLASTIC LEUKEMIA

### WITH REPORT OF CASES

By R. C. SATTERLEE, Lieutenant Commander, and F. W. WALKER, Lieutenant, Medical Corps, United States Navy

CASE 1.—M. P., female Chamorro, age 26, admitted April 30, 1927.

*Chief complaint.*—Cough and shortness of breath. History given was very scant. None of her relatives speak English. Patient had been in ordinary good health one month prior to entrance. She became ill enough to cause her to make complaint to her friends two weeks before admission. At that time she had pain in the left epigastric region, with shortness of breath, bleeding from the gums, and fever. No history of enlarged glands in cervical, axillary, or inguinal regions.

Patient is married and has three healthy children. No family history of any constitutional illnesses.

On admission, patient had a temperature of 102°. This fell to 100°, and remained between that and 101°. Pulse was always over 100; respiration, 35 on admisssion and remained about the same. Dyspnœa was marked and there was a deep cough. Patient slept well and ate well of a soft diet. Mental aspect, clear. No anxiety.

*Physical examination.*—Chamorro woman, age 26, thin, extremely anemic, breathes rapidly with labored effect. No cervical gland enlargement. Examination of chest shows lung bases congested, with many bubbling râles, and areas of dullness. Several examinations suggest lobar pneumonia with delayed resolution. Heart sounds rapid, weak, and regular. Pulse 120. Examination of abdomen shows liver easily palpable, slightly enlarged over its whole area, without tenderness or pain on deep pressure. Spleen enlarged and tender, with some pain on pressure.

*Course of disease.*—On the second day patient seemed more exhausted. Cough was severe, requiring morphia. Patient took nourishment. Bowels moved regularly after initial catharsis with magnesium sulphate. On the third day patient became extremely weak, dyspnœa increased markedly, and pulmonary congestion was very noticeable. Heart, regular; rate, 110. Temperature, 101°. She took very little of a liquid diet. On the fourth day, after a fairly good night's sleep, patient suddenly developed extreme restlessness and severe dyspnœa in the early morning and died at 8.15 a. m.

*Laboratory findings.*—Sputum negative for tubercle bacilli. Kahn test negative. Urine shows trace of albumin and many fine granular casts. Feces positive for ova of hookworm and ascaris. Blood count as follows: R. B. C., 2,400,000; W. B. C., 152,000; hemoglobin, 45 per cent. Differential count: Polys., 13 per cent; small lymphocytes, 19 per cent; myelocytes, 9 per cent; basophiles, 1 per cent; pathological large lymphocytes, 58 per cent. Many normoblasts and a few megaloblasts.

CASE 2.—J. D., female Chamorro, age 11, admitted April 29, 1927. History very poorly given, due to ignorance of English. Patient was apparently in good health one month prior to admission. The first symptom was a mild fever. Her mother noticed that she had lumps in her neck and under her jaws. The fever disappeared in two days; the swellings, presumed to be glandular, went away soon afterwards; and the patient was fairly well. That same week the patient was brought to the native clinic by her mother for treatment for worms, because the child had abdominal pains and had previously passed a round worm. Routine santonin and calomel treatment was given. The results were not noted, as the patient slept at home.

The next week the patient was not improved in health as is customary after worm treatment and she developed weakness and pains in the right chest and upper abdomen. The mother brought the patient to the hospital very weak, pale, and unable to stand up. Temperature, 100°; pulse, 105; respiration, 30. The mother said that the girl had grown extremely pale and weak within the last three days.

*Physical examination.*—Eleven-year-old girl, fairly well nourished, with pale color of skin, suggesting jaundice. Patient lay very still and seemed tired. Was fully conscious, cooperative, and cheerful. Sclera slightly yellow. Cervical glands moderately palpable. Submaxillary glands not felt. Mucous membranes of mouth pale; teeth and tonsils apparently normal. Examination of chest showed a few scattered râles only. Heart sounds normal, rhythm good, no murmurs. Abdominal examination showed liver much enlarged, its edge being 3 inches below rib border from sternum to nipple line, and even more from nipple line to midaxillary line. Liver, slightly tender. Spleen, palpable, but very slightly enlarged and with no pain or tenderness. Lower abdomen, negative. No increase in size of inguinal glands.

*Course of disease.*—The patient grew gradually weaker and more restless, a cough developed, and on the third day the patient vomited a moderate amount of bloody fluid. Food was taken until the fifth day. On the fourth and fifth day vomiting again occurred. Temperature ranged between 100° and 102°. Pulse remained at about 110. Respiration, about 30. On the fifth day the patient developed marked dyspnœa and died at 8.25 a. m.

*Laboratory findings.*—Kahn test negative. Feces positive for ova of hookworm, whipworm, and ascaris. Urine, negative. Blood counts follow:

| Date | R. B. C. | W. B. C. | Hgb. | Polys. | Lymphs. or lymphoblasts | Large monos. | Trans. | Eosin. |
|---|---|---|---|---|---|---|---|---|
| | | | *Per ct.* | | | | | |
| Apr. 29, 1927 | 1,680,000 | 20,100 | 25 | 8 | 81 | 7 | 2 | 2 |
| May 2, 1927 | 1,120,000 | 7,000 | 20 | 24 | 74 | 0 | 0 | 1 |
| May 4, 1927 | ---------- | 4,800 | ------- | 22 | 73 | 0 | 0 | 5 |
| May 5, 1927 | ---------- | 5,100 | ------- | 26 | 71 | 2 | 1 | 0 |
| May 6, 1927 | 1,140,000 | 5,200 | 10 | 18 | 82 | 0 | 0 | 0 |
| May 7, 1927 | 1,120,000 | 4,000 | 10 | 13 | 87 | 0 | 0 | 0 |
| May 9, 1927 | 1,760,000 | 4,000 | 10 | 24 | 76 | 0 | 0 | 0 |

Coagulation time, 30 seconds.

## DISCUSSION

In case 1 the first blood count suggested the diagnosis of leukemia because of the high leucocyte count (150,000). There remained the question of the type of leukemia. Ordinarily, leukemia is classified

as either acute or chronic, and either lymphatic or myelogenous. As to whether the disease is acute or chronic naturally depends on the course of the disease. The onset of the disease being unknown, other factors to consider are the number of white cells and the type of cells predominating.

In this case the history is scanty, but, probably, the onset was not much more than a month previous to admission, and, as death occurred in five days after admission, it is reasonable to consider the disease acute. The large number of unripe white cells in the blood tends to confirm this assumption. The leucocyte count was, however, somewhat higher than is usual in acute leukemia but still was within the possible limits. Hence, the diagnosis in this case lies between acute lymphatic leukemia and acute myelogenous leukemia, if the old classification is used.

At the first glance at the blood smear the type cell seemed to be a large lymphocyte. Further search showed a certain number of myelocytes, which were found to be not over 9 per cent in number and, hence, not inconsistent with lymphatic leukemia. The differentiation between the lymphocyte and its progenitor, the lymphoblast, and the myelocyte and its ancestor, the myeloblast, is supposed to rest on the presence in the latter of granules, as demonstrated by the peroxidase reaction. This stain applied to the blood of this case showed a count of granular cells not greater than the number of myelocytes and neutrophiles as shown by Wright's stain. So the type cell is nongranular in this case, and a tentative diagnosis of acute lymphoblastic leukemia was made. However, some authors consider that the earlier stages of the myelocyte, very young myeloblasts, are nongranular, and this means either that those authors are wrong or that a hard and fast diagnosis along lines of the old classification can not always be made.

Ordway and Graham, in their excellent article on leukemia in the Oxford Medical Series, state that "the essential point in the diagnosis of leukemia is the hyperplasia of the leucocyte-producing tissues and not the presence of an excessive high white count, nor the discovery of a certain percentage of abnormal white cells, which differentiates it from ordinary leucocytosis." Again, "a diagnosis of acute myelogenous leukemia in order to be above criticism must be substantiated by proof of the following points: (1) An aleukemic or subleukemic stage; (2) an acute downward course with death usually ensuing in one to four months; (3) the characteristic blood picture of myeloblasts and myelocytes with transitional forms between the two; (4) the typical gross and histological findings in the liver, spleen, bone marrow, and lymph glands; (5) the specific proof of myeloid elements by enzyme reactions."

This brings us to the post-mortem findings in this case, but, as these findings were almost alike in the two cases, it may be proper to discuss the laboratory findings in the other case first.

J. D., a young girl, walked into the hospital April 29 and 11 days later was dead. Her first blood count suggested either leukemia or infectious mononucleosis immediately, on account of the white count with over 80 per cent lymphocytes or lymphoblasts. The peroxidase stain of blood showed, as in the other case, the lack of granules in the type cell. The rapidly developed anemia tended to eliminate the diagnosis of infectious mononucleosis. Incidentally, there was no evidence of Vincent's angina, a condition which occasionally gives a marked lymphocytosis. The surprising development of a leucopenia complicated the diagnosis, but the persistence of the abnormal cell type made the diagnosis of aleukemic leukemia probable. If the first blood picture had been the same as later ones, aplastic anemia would have been considered.

Autopsy was done in each of these cases and pathological sections were made, as well as marrow smears. Mouth lesions were found, with ulceration and hemorrhages. It is interesting to note that the principal complaint of one of these cases was bleeding from a "tooth." No marked hyperplasia of cervical lymph glands was found. Slightly enlarged bronchial, mesenteric, and retroperitoneal lymph glands were found. The largest was not much larger than a lima bean. On cut section, they were reddish in color. No marked enlargement of the thymus was found.

A hemorrhagic pleural exudate and a mild broncho-pneumonia seemed to be the immediate cause of death in both cases. The liver was definitely enlarged in both cases, but the spleen only slightly so. Heart and blood vessels were devoid of gross pathology. Bone marrow in long bones was dark red in color and of jellylike consistency. Smears from bone marrow, stained by Goodpasture's stain, showed a slightly smaller percentage of granular cells than the blood.

Histologically, the spleen and lymph glands seemed to be composed almost entirely of mononuclear cells similar to lymphoblasts. The liver in one case showed a diffuse infiltration in various portions with these cells, while the other case showed them grouped only about the blood vessels. In both cases the lungs and kidneys showed considerable infiltration. The peroxidase stain applied to the cells in these tissues did not show the presence of granular cells.

In conclusion, it seems that a diagnosis of acute lymphoblastic leukemia is justified in both cases, one being aleukemic. The admission of two of these cases on successive days in a small hospital, such as the United States Naval Hospital, Guam, is remarkable.

# TRAUMATIC RUPTURE OF THE SPLEEN

## REPORT OF CASE

By WILLIAM L. IRVINE, Commander, Medical Corps, United States Navy

W. A. H., midshipman, fourth class, was kicked in the left side while playing football on the afternoon of September 7, 1927. Experienced pain during the night but did not report the fact to a medical officer until the following morning, when it was found that his condition was such that he was unable to go to sick quarters. He was transferred to the hospital immediately.

Physical examination upon admission showed signs of internal hemorrhage; pallor; pulse of 130 to 140 and weak and thready; R. B. C., 3,000,000; Hb., 60 per cent. Percussion dullness in both flanks; most marked on the left. After a transfusion of 500 cubic centimeters of citrated blood and 250 cubic centimeters of normal saline his circulation and general condition improved greatly and he passed a fairly good night.

About 10 a. m. the following day he turned over in bed and a few minutes later went into a condition of extreme shock and evidently had a second severe hemorrhage. R. B. C., 2,800,000; Hb., 60 per cent. He was again transfused with 500 cubic centimeters of citrated blood and 160 cubic centimeters of saline and prepared for laparotomy.

*Operation*, September 9, 1927. Left rectus incision under regional anæsthesia and the remainder of the operation under nitrous oxide-oxygen anæsthesia, with the addition of about 2 ounces of ether. The abdomen contained a large amount of free blood and blood clots, the latter confined mostly to the upper left abdomen. The spleen was delivered and a V-shaped rupture of the anterior border found. The pedicle was clamped and splenectomy done. Incision closed without drainage.

Post-operative recovery was good except for an acute attack of tachycardia on the evening of the second day which caused some anxiety—as it was thought for a few minutes to be a secondary hemorrhage. Subsequently, convalescence was uneventful, with the exception of tachycardia which appeared on slight exertion and persisted for about six weeks after operation. (Moynihan mentions tachycardia as one of the after results of splenectomy.) One week after splenectomy red blood cells numbered 4,250,000 and hemaglobin was 80 per cent. On October 28, 1927, three days before he returned to duty, the red cells were 4,350,000 and the hemaglobin 92 per cent. Two months have elapsed since discharge to duty.

Inasmuch as this patient was a fourth-class midshipman the question arose as to the advisability of h's further retention in the Naval Academy. It was finally decided to give him a trial. With reference to this question a recent article abstracted from the British Journal of Surgery by the Journal of the American Medical Association is of interest and is quoted as follows:

*Traumatic rupture of normal spleen.*—Thirty-two cases are analyzed by Bailey. Experiments on animals have led investigators to believe that splenectomy lowers resistance to infection. Bailey traced 13 persons who have had a ruptured normal spleen removed. Two of these were operated on 14 and 13 years ago, respectively. In the remainder, between 3 and 11 years has elapsed since the operation. In no instance is there the slightest indication that a splenectomized person is more susceptible to infection than the rest of humanity.

# ACUTE ATROPHY OF THE LIVER ASSOCIATED WITH THE INTRAVENOUS ADMINISTRATION OF NEOSALVARSAN

By R. M. Choisser, Lieutenant Commander, and P. W. Wilson, Lieutenant Commander, Medical Corps, United States Navy

## Report of Case

Fatalities following the use of neosalvarsan are not especially uncommon; however, the exact way in which the drug produces its deleterious effect is often unusual and extremely interesting. The case reported below, while not particularly rare, is of sufficient interest, we believe, both from the clinical and pathological point of view to warrant publication. We shall not attempt to go into a lengthy discussion of the various theories advanced as to why the drug reacts differently with different patients or why in certain cases the liver seems to be the only organ to suffer. We desire, on the contrary, simply to present the salient facts in the clinical history together with the necropsy findings and leave any theoretical conclusions to the reader.

Weis[1] reported 8 fatalities in arsenic jaundice cases in New York, while Strathy, Smith, and Hanna, in 1917 and 1918, had the same number of deaths among 58 cases of "jaundice with symptoms of liver atrophy." It is believed by some that the reaction is due to the death of great numbers of spirochetes in the liver, with a subsequent Herxheimer effect, while Herxheimer himself believes the liver atrophy is entirely the result of the spirochete, and considers its following an arsenic administration as purely coincidental.

At the Haitian General Hospital, Port au Prince, an average of 10,000 intravenous injections of neosalvarsan are given annually, and it is interesting to note that this is the first case to show such an extreme reaction. Many cases, of course, have the usual febrile reactions following intravenous neosalvarsan, some with jaundice. All, however, have cleared up within a few days.

The case reported below is of interest for two reasons: First, on account of the clinical symptoms presented by the patient, and, second, on account of the unusual gross appearance of the liver at necropsy, which was most confusing at the time and required a microscopic examination before its true nature was known.

## Case Report

Case No. 8202, A. C., woman, 24 years old, admitted to the Haitian General Hospital, Port au Prince, Haiti, September 15, 1927, complaining of swelling of the feet and legs, jaundice, constipation, loss of appetite, thirst, dizziness, and weakness.

*History of present complaint.*—Patient states that she came to the outpatient department six or eight weeks before admission to take a series of neosalvarsan

[1] Osler's Modern Medicine, vol. 2, p. 672.

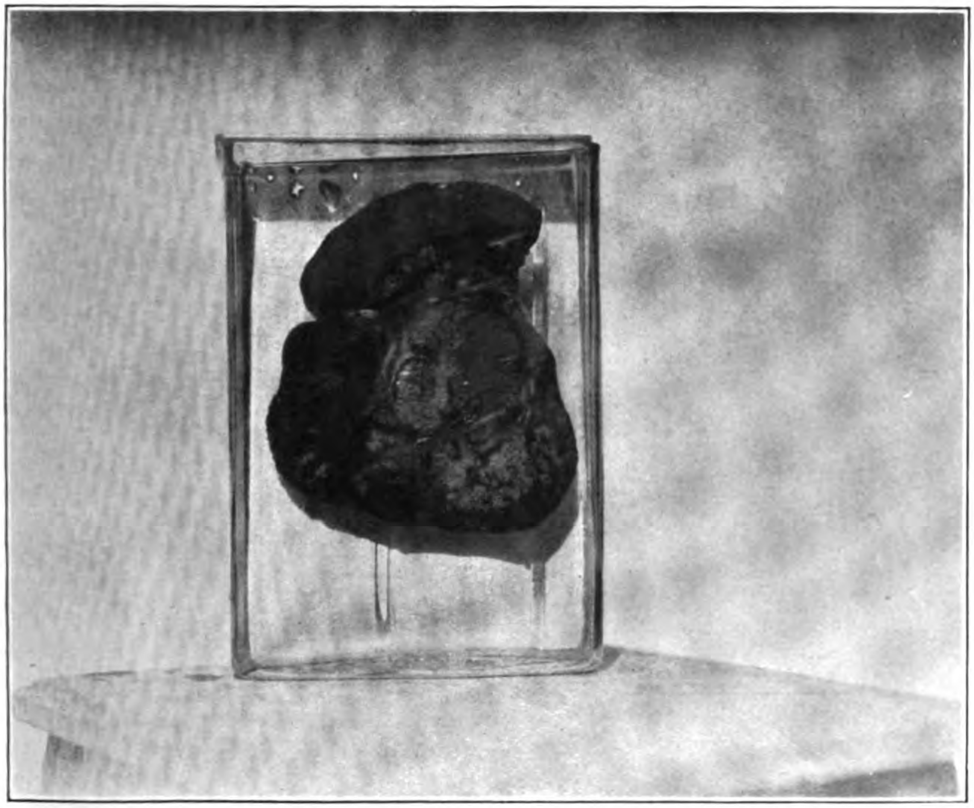

FIG. 1.—CUT SECTION OF LIVER SHOWING YELLOW IRREGULAR MASSES

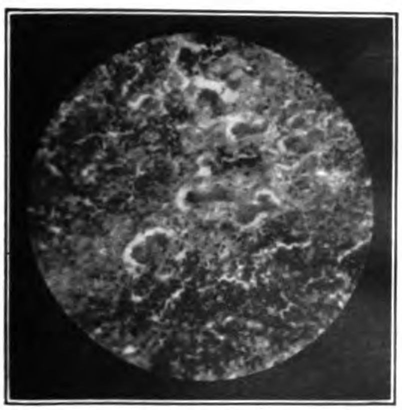

FIG. 2.—ACUTE YELLOW ATROPHY WITH REGENERATION OF THE LIVER

injections for "general weakness" which she had had for some months. Within a day or two after the last injection of neosalvarsan on September 5, she noticed that her eyes were jaundiced, and four days later her feet started to swell. The day before admission she frequently felt that she was about to faint but did not actually do so. She had marked thirst, loss of appetite, and dizziness for the same period, and had vomited several times during the two days before admission.

*Past history.*—"General edema" when a child; mumps, measles, smallpox in 1920; two or three attacks of "fever" (probably malaria) every year for the past several years, and gonorrhœa.

*Physical examination.*—Marked jaundice of the scleræ. Liver margin felt two fingers' breadth below the costal margin and slightly tender to pressure. The gall-bladder region was not more sensitive than the rest of the liver. The heart sounds were clear; no murmurs and no hypertrophy were demonstrated. Blood pressure: Systolic, 118; diastolic, 64.

*Laboratory findings.*—Blood serum (Kahn), September 16, positive, 4 plus; blood negative for malaria (thick film); white blood cells, 5,000; polymorphonuclears, 56 per cent, lymphocytes, 40 per cent, large mononuclears, 2 per cent, eosinophiles, 2 per cent; nonprotein nitrogen of the blood, 25 milligrams; creatinine, 1.3 milligrams; icterus index, 25. Urinalyses (October 4, 10, 18, 20, 22, 24, 25, and 27) showed specific gr[illegible]ariation from 1.004 to 1.035; no albumen; no sugar; and nothing of importance microscopically. Hemoglobin, 80 per cent on September 15 and 55 per cent on October 14.

*Clinical course.*—On admission, patient was placed on a meat and fat free diet, with dilute hydrochloric acid before meals. Vomiting stopped two days after admission, and within a week jaundice was noticeably improved, but the weakness and anorexia continued. On the 22d of September patient received 0.3 gram neosalvarsan by mistake, which was not discovered by the doctor in charge of the ward until the following day. She had suffered no apparent reaction from this injection, but it was decided to give her 5 cubic centimeters of 5 per cent sodium thiosulphate solution, and this was done September 23. During the first two weeks of hospitalization the patient seemed to improve considerably. During this time the edema of the feet disappeared and the temperature dropped to normal, from a daily afternoon rise to 100° during the first week. The administration of 15 grains of potassium iodide was started on October 18, but was discontinued five days later because of symptoms of iodism. A few days prior to the administration of the iodide it was noticed that she had a generalized edema with slight ascites. On the 25th of October patient began to complain of pain and tenderness in the anterior surface of both thighs. Occasional attacks of abdominal colicy pains began at this time which persisted to the end of her consciousness. The ascites grew progressively more pronounced and the vomiting became persistent and uncontrollable until the end. Her temperature started to rise on the 16th of October and varied from 100° to 103° in the afternoon, but never at any time was there any marked increase in the pulse, except what one would expect with the fever, until just before her death. On October 30 patient became quite restless and the following day was delirious and remained so until she became comatose the day before her death, November 3. Blood pressure, November 2, was: Systolic, 140; diastolic, 80.

### *Post mortem report*

The body is that of a poorly developed Haitian female, 24 years of age. Height, 65 inches; weight, 90 pounds. No evidence of violence. Skin dry;

otherwise negative. Rather marked edema is present in both legs. Abdomen not distended. Scalp shows no unusual change. The eyes are dry and appear cloudy. Scleræ are pale yellow in color. The mouth, face, nose, ears, and neck appear normal.

The usual midline incision reveals very little subcutaneous fat, with pale, poorly nourished muscles.

Right pleural cavity shows nothing unusual; no fluid or adhesions present. The left pleural cavity is also normal except for a few adhesions: no fluid. The right lung, weight 545 grams, shows marked congestion at the base of lower lobe; it is air-bearing throughout. Left lung, weight 650 grams, is markedly congested and very edematous. It is air-bearing. The trachea and bronchi appear normal. Mediastinal nodes not enlarged. Thymus not present.

Pericardium is smooth, glistening, and contains about 50 cubic centimeters of clear pale yellow fluid.

The heart shows nothing unusual. Weight, 270 grams. The muscle walls and valves show no gross change. The aorta is rough and covered with numerous yellow degenerative patches. Coronaries are patent.

Peritoneum is smooth. The abdominal cavity contains about a liter of clear yellow fluid. Stomach and intestines are negative for gross lesions. Mesenteric and retroperitoneal nodes are not enlarged. Pancreas is regular in outline, yellow in color, and very firm to touch; weight, 105 grams.

Liver is small, 750 grams, dark red in color, and nodular on the inferior surface. Cut section shows numerous yellow irregular masses varying in size from a pea to a pigeon egg. The distribution is similar to that of a metastatic neoplasm; however, the appearance is not unlike that of normal pancreatic tissue. These masses have replaced about half of the liver substances. Gall bladder contains no calculi. Both kidneys are large; weight, right, 195 grams; left, 190 grams. No gross changes found. Adrenals, ureters, and bladder are negative. Uterus, fallopion tubes, and external genitalia show no gross changes. The superficial lymphnodes show no general enlargement.

*Anatomical diagnosis.*—Edema and congestion of both lungs; ascites; aortitis; pancreatitis; neoplasm of liver, the nature of which is unknown.

*Cause of death.*—Edema of lungs associated with hepatic insufficiency. Miscroscopic section of liver shows the yellowish, neoplasticlike areas to be young normal liver cells and the red portion of the liver to consist entirely of degenerated masses of old liver cells, bile ducts, and hemorrhage.

*Diagnosis.*—Acute degeneration of liver with beginning regeneration.

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## TARTAR EMETIC IN THE TREATMENT OF CHANCROIDAL ULCERS OF THE PENIS

By O. Davis, Lieutenant Commander, Medical Corps, United States Navy

Following the appearance in the *Journal of the American Medical Association* (vol. 88, No. 22) of an article describing the treatment of chancroidal infections with tartar emetic, the treatment outlined in the article was instituted on the U. S. S. *Helena* in all cases of chancroid of the penis which occurred on board this ship. These notes are made on a basis of 16 cases so treated. In the course of an intensive antivenereal campaign conducted aboard this ship these cases either reported at the sick bay for treatment or were picked up at the weekly venereal inspection of the entire crew. Routine

dark-field examinations of the penile sores were made in each case and were negative in the cases reported. In spite of a personal belief that a great percentage of the penile sores on this station (South China) are mixed infections, a belief borne out by examination of men aboard ship who had had diagnoses of chancroid of the penis made and later developed signs of syphilis, treatment was begun on all penile sores in which no spirochetes were demonstrable.

All cases were treated with 616 "A" and "B," as described in the NAVAL MEDICAL BULLETIN of July, 1924, which have been giving satisfactory results. Following the use of tartar emetic in addition to the above, a very noticeable improvement in the appearance of the sores occurred, and the time for healing was decreased in all cases, healing usually occurring in from 1 to 10 days, and without the development of any inguinal adenitis or any other complication.

In a series of 16 cases occurring within a period of four months, excluding those cases known to be syphilitic, healing occurred in every case but 3 within a period of 10 days; and the 3 resistant cases were later proved to be syphilitic, 1 by a typical secondary eruption, and all 3 by positive Kahn reactions. No toxic symptoms from the drug were observed in any of the cases except the 3 resistant ones, and in these only during their second course of intravenous injections, where the symptoms complained of were nausea, vomiting, and some tingling sensations in the extremities. Three cases healed after 1 injection, 4 cases after 3 injections, 3 cases after 5 injections, 1 case after 6 injections, 1 case after 7 injections, 1 case after 8 injections, and the 3 resistant cases after 2 courses of 8 injections each.

Following the method of treatment outlined in the above reference, a 1 per cent solution of tartar emetic was given intravenously, beginning with a dose of 3 cubic centimeters and increasing this amount by 1 cubic centimeter every other day until healing occurred or until the maximum dose of 10 cubic centimeters was reached, when treatment was stopped. Jones, in the above article, claims that there is less tendency to reaction from the drug if freshly distilled water is first sterilized and the drug then added, the solution then being used without further sterilization; this method of procedure was used in preparing the solution for intravenous use.

The 16 cases presented, while comparatively a small number, were under constant observation until healing took place. Jones, in his article, was not able to give the end results in all his cases.

The object in presenting an observation on this method of treatment is not to offer it as a cure-all for chancroidal ulcers of the penis but to recommend it as a valuable adjuvant to the many means of local treatment now being used. Certainly, the decreased number of days required for healing, and more particularly the absence of com-

plications—inguinal adenitis and ulceration—make it a procedure worth while. This is particularly true in the naval service, where men are under constant observation and can be given medication regularly.

Naval personnel are conversant with the term "bubo," and know what suffering and inconvenience this condition causes; some by personal experience, and others by observation of their shipmates; therefore any method of treatment which offers a reasonable possibility of avoiding the occurrence of such a complication appeals strongly to them, as it does also to the medical officer. The discomfort attendant on the intravenous injections is practically nil, so there is not any objection on the part of the patient to this added medication in the treatment of chancroid of the penis. Another valuable feature of this method of treatment is the absence of pain and soreness in the ulcer after one or two intravenous injections of the drug.

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## TOURNIQUET SPLINT FOR FRACTURES OF THE ELBOW

By RAYMOND SPEAR, Captain, Medical Corps, United States Navy

In the treatment of fractures of the elbow the first essential, of course, is to know the exact deformity by X-ray examination. The fragments should then be reduced under an anesthetic and the arm placed, ordinarily speaking, in Jones's position or some position similar to it.

Three cases of fractured elbows at the San Diego naval hospital, all in children, have been treated by means of what we call the tourniquet splint. It is made by doubling the ordinary rubber tourniquet, passing it around the neck, and securing this loop with a piece of adhesive plaster so as to leave plenty of room for the neck and avoid any strangulation. One free end of the rubber tubing is passed behind the wrist joint and the other in front, and the two ends are secured by another small piece of adhesive plaster. The wrist is padded with cotton and a bandage so as to avoid any pressure from the rubber tourniquet. The position of the arm can be changed slightly from time to time very easily.

The advantages of this splint are its simplicity and the fact that a certain amount of motion is obtained in the joint at all times. This splint is much more comfortable than many other types of splints that are used for fractures at the elbow joint, and the results in the three cases mentioned in which this splint has been used here have been almost perfect.

The side view is of a little girl suffering from a T fracture of the lower end of the humerus. The little girl shown in the front view had a fracture of the head of the radius.

FIG. 1.—PATIENT WITH T-FRACTURE OF THE LOWER END OF THE HUMERUS

358—1

FIG. 2.—PATIENT WITH FRACTURE OF THE HEAD OF THE RADIUS

358—2

## NAVAL RESERVE

### PROMOTION OF SPECIAL SERVICE OFFICERS

After December 22, 1927, the following provisions governing the promotion of special service officers are effective:

In time of peace, special service officers below the rank of lieutenant commander will be promoted only in accordance with the following:

(*a*) Provided a vacancy exists in the district quota, in the grade to which promotion is to be made (not more than 16 per cent above the grade of lieutenant; and not more than 53 per cent above the grade of lieutenant, junior grade).

(*b*) Provided that, if an ensign, the candidate shall have served four years in grade, or if in a higher rank he shall have served six years in that grade, prior to effective date of promotion.

(*c*) Provided he shall have reached the age of 37 before being promoted to the grade of lieutenant commander.

(*d*) Provided he shall have made such marked progress in his professional attainments as would justify his commission in the higher grade.

This establishes more uniform requirements for promotion of special service officers which are on a parity with the requirements for promotion in the Fleet Reserve and Volunteer Reserve, general service, and makes standard the distribution of commissioned officers by grade within the individual districts and within the class to which they belong.

### OFFICIAL CORRESPONDENCE

Reserve medical officers frequently request that for their guidance instructions be published on the subject of official correspondence. Most reserve medical officers do not have convenient access to Naval Reserve Regulations, and the following is quoted from that source:

#### H-1436. Official Channels for Correspondence

Whenever officers and men of the Naval Reserve find it necessary to write a letter to one of the bureaus of the Navy Department, it shall be routed via the commanding officer of the organization to which attached and the commandant. If the letter refers to com-

pensation for which no voucher was forwarded to the Bureau of Supplies and Accounts in time to make payment prior to the writing of the letter probable (allowing time for the passage of mail and 10 days additional), the official whose duty it is to forward the voucher will make appropriate reply and file the letter.

#### H-1437. File Numbers of Personnel

(1) The file number on correspondence regarding a particular officer shall be the file number assigned him by the Bureau of Navigation. This file number should be shown in the upper left-hand corner of correspondence originated by a Naval Reserve officer about himself and shall be used by the commandant and by organization commanders having occasion to write about any particular officer. Example: 19215.

(2) The file number on correspondence regarding a particular enlisted man shall be his name, service number, rating, and class. Example: John Henry Jones, 130-50-72, CBM (F-1), USNR.

#### H-1438. Correspondence to be Dated

All correspondence shall be dated in the upper right-hand corner, as shown in the following example:

1 January, 1926.

#### H-1439. Official Residence to be Shown in Origin of Correspondence

The permanent official residence shall be shown in the origin of correspondence as follows, for example:

From: Lieutenant (jg) John H. Jones (D-F), USNR,
123 East 34th St.,
New York, N. Y.

#### H-1440. References to be Quoted in Correspondence

When a letter is in reply to or refers to previous correspondence, quote under "References" the file number, every distinguishing mark, and the date of such correspondence. Where more than one reference is given enumerate by small letter (a), (b), (c), etc. The following form should be used:

Reference: (a) BuNav letter Nav 163 Em 12356-37 of 1 July, 1925.

#### H-1441. When Indorsements Shall be Used

As a general rule, a letter shall be answered by a separate letter and not by indorsement. (Navy Regulations, 1920, art. 2010.)

### H-1442. Extra Copies of Correspondence Not Desired by Bureau of Navigation

Extra copies of correspondence should not be forwarded to the Bureau of Navigation unless specially requested. The original is sufficient to meet the demands of the bureau.

### H-1443. Addresses of Officers

(1) Naval Reserve officers when first appointed shall inform the Bureau of Navigation, via the commandant of their district, of their permanent official residence and shall keep the bureau promptly informed, via the commanding officer of their organization and the commandant of their district, of all changes made thereafter. In time of peace they may change their place of permanent official residence at will, but whenever a change is made it shall be reported to the Bureau of Navigation, via the commandant of the naval district in which formerly residing, by the officer making the change.

(2) Permanent official residence is defined as the place in his district near the organization which he is attached to or associated with, where the bureau may at any time send a letter or telegram and expect prompt delivery to the addressee.

(3) This report of address or change of address should be made by letter, preferably on your 8 by 10½ business letterhead stationery, by typewriter if practicable.

(4) The form shown below should be followed:

12356 1 July, 1925.

From: Lieutenant John H. Jones (A-F), USNR,
601 West 113th St.,
New York, N. Y.

To: Bureau of Navigation,
Via: Commandant Third Naval District.

Subject: Change of address.

Reference: (a) Bureau of Navigation Manual, article H-1443.

1. In compliance with reference (a), I request that my address be changed
From: 601 West 113th St.,
New York City.
To: The Westminster,
17th and Que Sts. NW.,
Washington, D. C.

(s) J. H. Jones.

Distribution:
Original: BuNav.
Duplicate: Comdt. 3rd N. D.
Triplicate: My file.

(5) When the address letter passes through the hands of the commandant, he shall correct his address file and effect any transfer of record necessitated thereby. The letter transmitting the records

should state the new address of the reserve officer. A copy of this letter should be mailed to the Bureau of Navigation.

(6) When change-of-address letters are received in the bureau, the records of the bureau will be corrected accordingly. The bureau believes it to be unnecessary to acknowledge the receipt of these letters, and therefore such an acknowledgment should not be expected.

(7) A card index of officers' addresses is maintained in the Bureau of Navigation. The accuracy of this list is considered to be of the greatest importance. In the event of war the bureau should be able to mobilize every reservist immediately. Cooperation of everyone in conserving labor and keeping this list corrected is confidently expected.

### H-1444. Changes of Address of Enlisted Men

(1) Whenever an enlisted man changes his official residence he shall notify the commandant of his district via the commanding officer of his organization.

(2) Transferred members of the Fleet Reserve shall notify the commandants of their naval districts of changes of residence.

### H-1445. Changes of Address to be Reported to the Bureau of Supplies and Accounts

All transferred members of the Fleet Naval Reserve and all members of the Merchant Marine Naval Reserve shall notify the Bureau of Supplies and Accounts (Allotment Division) via the commandant of the naval district where their records are kept of changes of address to which checks are to be mailed. S. and A Form 444d will be used for this notice and must be signed with the full name of the reservist. Notices given in any other manner will operate to delay the checks until a notice is received in the form and manner prescribed.

*Comment*

The name of the signer of any official letter should be either typewritten, printed, or plainly lettered under his signature. Unless one is familiar with a particular signature it usually proves to be an enigma.

In the case of medical officers of the Naval Reserve one copy of the change of address should be sent to the Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

*New appointments*

| Name | Rank | Class | Date appointed |
|---|---|---|---|
| Agnew, John Robert | Lieutenant (junior grade) | MC-V(G) | Jan. 18, 1927 |
| Bloomfield, Maximilian D | Lieutenant commander | MC-V(S) | Dec. 1, 1927 |
| Bowen, Harold Jenkins | Lieutenant (junior grade) | MC-V(G) | Oct. 24, 1927 |
| Brown, Charles W | Lieutenant commander | MC-V(S) | Oct. 31, 1927 |
| Cadman, Robert Blackmore | Lieutenant | MC-V(S) | Oct. 24, 1927 |
| Davis, William John N | Lieutenant (junior grade) | MC-V(G) | Oct. 8, 1927 |
| Hosmer, Charles M | Lieutenant commander | MC-V(S) | Oct. 31, 1927 |
| Koehler, Joseph S | Lieutenant (junior grade) | MC-V(G) | Nov. 23, 1927 |
| Konzelmann, Frank W | Lieutenant | MC-V(S) | Oct. 31, 1927 |
| Lee, Edgar Coote | Lieutenant commander | MC-V(S) | Oct. 31, 1927 |
| MacKenzie, Pierce | Leiutenant (junior grade) | MC-V(G) | Dec. 19, 1927 |
| Mayne, Roy Malone | Lieutenant (junior grade) | MC-V(G) | Nov. 2, 1927 |
| Mickle, Raymond E | Lieutenant (junior grade) | MC-V(G) | Oct. 17, 1927 |
| Moch, Jerome J | Lieutenant (junior grade) | MC-V(G) | Oct. 8, 1927 |
| Oden, Robert | Lieutenant commander | MC-V(S) | Nov. 26, 1927 |
| Raymond, Sidney W | Lieutenant (junior grade) | MC-V(G) | Oct. 17, 1927 |
| Rhame, Joseph Sumter | Lieutenant commander | MC-V(S) | Dec. 12, 1927 |
| Rothwell, Herbert T | Lieutenant (junior grade) | MC-V(G) | Aug. 31, 1927 |
| Rudisill, Clarence A | Lieutenant (junior grade) | MC-V(G) | Oct. 31, 1927 |
| Smith, William R | Lieutenant (junior grade) | MC-V(G) | Nov. 8, 1927 |
| Taber, Roland Bert | Lieutenant commander | MC-V(G) | Oct. 8, 1927 |
| Thompson, Harold A | Lieutenant commander | MC-V(S) | Oct. 31, 1927 |

*Transfer*

| Name | Rank | To class— | From class— | Date |
|---|---|---|---|---|
| Barner, Henry A | Lieutenant (junior grade) | MC-F | MC-V(G) | Nov. 16, 1927 |

*Promoted*

| Name | To— | Class | Date |
|---|---|---|---|
| Dougall, John Park | Lieutenant commander | MC-V(G) | Dec. 7, 1927 |

# NURSE CORPS

### USEFUL INFORMATION CONCERNING REGULATIONS

There are many naval decisions and regulations of interest to the Nurse Corps, of which the nurses in general have no knowledge. These are published in Navy Regulations and in pamphlets which are on file at every station but not always of easy access to the nurses. It has seemed wise, therefore, to cover some of these in brief so that nurses may be better informed on this subject. As they have free access to the Manual of the Medical Department and are urged to study this manual, no inclusion is made in this article of regulations especially prescribed for the Medical Department of the Navy, of which the nurses are an integral part.

In the application of general orders, unless special legislation is enacted for the Nurse Corps, the nurses are governed by orders for commissioned officers.

Chapter V of Navy Regulations gives the " Honors, distinctions, salutes and ceremonies." But little of the chapter has been included in this article, as it would be difficult to single out any special person or group without mentioning each one, and in every case the honors are different for persons of different rank. It is a very interesting chapter, however, and it is recommended that the nurses read it carefully so that when they are aboard hospital ships and transports, especially, they will have a clearer understanding of the honors paid, and the exchange of salutes when one ship of the Navy meets another.

Changes in the Navy Regulations and general orders are issued from time to time and it is hoped that by reading this brief extract, the interest of the nurses will be so much aroused that they will make every effort to familiarize themselves with the regulations and orders already published and with those that will be issued from time to time.

There is at the seat of government an executive department, known as the Department of the Navy, with a Secretary of the Navy as the head thereof.

In the absence of the Secretary of the Navy and the Assistant Secretary of the Navy, the Chief of Naval Operations is next in succession to act as Secretary of the Navy.

No person shall be appointed to any office in the Navy unless he is a citizen of the United States. Permission to leave the United States will be granted by the Secretary of the Navy only.

The principal naval force of the United States is organized as "The United States Fleet." Forces not assigned to the United States Fleet are organized as separate commands as follows:

(*a*) Asiatic Fleet.
(*b*) Naval forces, Europe.
(*c*) Special service squadron.
(*d*) Submarine divisions, Atlantic.
(*e*) Submarine divisions, Pacific.
(*f*) Naval district forces.

The United States Fleet is under command of an admiral, with the title of "commander in chief, United States Fleet." The Fleet is composed of:

(*a*) The Battle Fleet, under command of an admiral.
(*b*) The Scouting Fleet, under command of a vice admiral.
(*c*) Control force, under command of a rear admiral.
(*d*) Fleet base force, under command of a rear admiral.

The Asiatic Fleet is commanded by an admiral with the title of "commander in chief, Asiatic Fleet." The geographical limits of the command include the western Pacific and the Indian Oceans, and tributary waters. The naval forces, Europe, are commanded by a vice admiral; the special service squadron by a rear admiral; the submarine divisions by a rear admiral or captain; and the naval district forces are under the command of the commandant of the naval district to which assigned.

Transportation of passengers on naval ships is regulated by the Bureau of Navigation. No officer embarked as a passenger shall be entitled to a stateroom to the exclusion of an officer belonging to the complement of the ship. Officers embarked as passengers shall mess in the apartment to which they would belong if attached to the ship. An order from the Chief of the Bureau of Navigation to the commanding officers of the Navy transports states "when members of the Navy Nurse Corps are embarked in a transport, either for passage or for duty for the trip, they are to be regarded as of the status of officers in the assignment of quarters, mess, etc."

The Navy Department designates such vessels as it may deem necessary to be called and employed as "hospital ships." Hospital ships are employed for the purpose of caring for, treating, and transporting the sick and wounded of the Navy, Marine Corps, and Army, as well as shipwrecked and other persons requiring medical service, and are under the general cognizance of the Bureau of Medicine and Surgery, so far as all matters pertaining to the distinctly hospital features of the ship are concerned. No persons other than those enumerated shall be transported aboard hospital ships in time of war. The medical officer of the ship is the head of the medical department of the ship. He is in direct charge of the sick and wounded

and has charge of all material and stores aboard under the cognizance of the Bureau of Medicine and Surgery. Dental officers are assigned to the medical department of a ship.

The Bureau of Medicine and Surgery has power to appoint and remove all nurses in the Nurse Corps, subject to the approval of the Secretary of the Navy.

All persons in the naval service shall be vaccinated with smallpox vaccine and given typhoid prophylaxis in accordance with instructions contained in the Manual of the Medical Department.

Officers and enlisted men of the Navy and Marine Corps, when on duty at a place where there is no naval hospital, may be sent to other hospitals, upon the order of the officer in charge, and the expenses of such persons shall be paid from the naval hospital fund; no other charge shall be made against their accounts than such as are made for persons under treatment at naval hospitals. Sick, wounded, or disabled officers and enlisted men of the Navy and Marine Corps, and members of the Navy Nurse Corps, are entitled to the benefits of naval medical and surgical attendance, either within or without a naval hospital, so long as they remain sick, wounded, or disabled, and the fact that they have been recently treated within a naval hospital shall not prevent their readmission to the same or to any other naval hospital.

Dental officers are assigned to the medical department of the station to which they are attached and are under the general supervision of the medical officer. The professional services of dental officers are available only for personnel on the active and retired list of the Navy and Marine Corps, and such services are restricted to those measures which will most effectively and economically preserve the teeth of the personnel and insure physical fitness. Dental treatment is regarded as included in the term "medical attendance." Prosthetic dental treatment will be allowed only when authorized in advance by the Bureau of Medicine and Surgery.

A member of the Navy Nurse Corps detached from all duty at her permanent station and directed to proceed to a hospital for treatment is entitled to rental allowance during period of travel to hospital and while a patient therein.

Nurses receiving a subsistence allowance will continue to receive the allowance during such period as they may be subsisted and quartered in a hospital under treatment, but they will be checked for each day for which subsistence actually is furnished, at the rate fixed in the current appropriations act as the commuted value of a hospital ration.

The American National Red Cross has been authorized by an act of Congress, approved April 24, 1912, to render aid to the land and naval forces in time of actual or threatened war. Organized Red Cross units, if accepted for service with the naval forces, will be

enrolled as members of the Naval Reserve Force and will constitute a part of the Medical Department of the Navy. One or more officers of the Medical Corps of the United States Navy will be detailed for duty with the military relief division or department of the American Red Cross, the senior one of whom shall act as liaison officer between the American National Red Cross and the Navy Department. When the Navy Department desires the use of the services of the Red Cross in time of war or when war is imminent, the Secretary of the Navy communicates with the chairman of the Red Cross, specifying the character of the services required and designating the place or places where the personnel and material may be assembled.

The United States and island possessions are divided into 16 naval districts. The first district covers some of the New England States, with headquarters at Boston. The other districts follow numerically and somewhat geographically in order, up to the thirteenth, which, along with the Northwestern States, takes in Alaska, and the headquarters are at Seattle. The fourteenth district covers the Hawaiian and the Midway Islands; the fifteenth, the Panama Canal Zone; and the sixteenth, the Philippine Islands. Each naval district is commanded by a designated commandant, who is the direct representative of the Navy Department. The Virgin Islands, Guam, Samoa, and Porto Rico, and the naval station at Guantanamo Bay are not included in the naval districts but are under naval governors.

Whenever the national anthem is played, stand at attention facing toward the music, except at colors, then face toward the colors. If in street uniform, covered, salute at the first note of the anthem, retaining the position of salute until the last note of the anthem. If in uniform, uncovered, or in indoor uniform, stand at attention. The same marks of respect prescribed for observance during the playing of the national anthem of the United States shall be shown toward the national anthem of any other country whenever played upon official occasions.

A national salute shall consist of 21 guns. The interval between guns in all salutes shall be five seconds. No salute shall be fired in honor of any nation or of any official of any nation not formally recognized by the Government of the United States. No salute shall be fired between sunset and sunrise.

An escort under arms shall accompany the funeral cortège of any officer or enlisted man to the place of interment, and after the funeral service shall fire three volleys of musketry over the body. The strength of the escort varies according to the rank of the deceased. A band shall, when available, form part of the funeral cortège of the Secretary of the Navy, Assistant Secretary, and commissioned officers, or on other occasions when deemed appropriate

by the senior officer present. There shall be six pallbearers, who shall be selected from the same rank as the deceased if practicable. The pallbearers shall march at the side of the hearse or pall, the junior to the left and leading, the next junior to the right and leading, and so on. Eight men serve as body bearers and march immediately behind the body. Funeral honors shall not be paid between sunset and sunrise. Volleys shall be fired for naval or military persons only.

The Secretary of the Navy is authorized, at his discretion, to issue free of cost the national flag used for draping the coffin of any officer or enlisted man of the Navy or Marine Corps whose death occurs while in the service of the United States Navy or Marine Corps, upon request, to the relatives of the deceased officer or enlisted man, or, upon request, to a school, patriotic order, or society to which the deceased officer or man belonged. Officers in command of navy yards, vessels, and naval hospitals are authorized to issue flags to accompany all bodies forwarded or delivered to the next of kin or relatives for private interment. If no request for the flag is made, the officer in charge holds the flag (properly tagged with name of deceased and date of funeral) for a period of three months in case a request should be made for the flag.

All persons in the Navy are required to obey readily and strictly and to execute promptly the lawful orders of their superiors. Summary courts-martial may be ordered upon petty officers and persons of inferior ratings, by the commander of any vessel, or by the commandant of any navy yard, naval station, or marine barracks to which they belong, for the trial of offenses which such officer may deem deserving of greater punishment than such commander is authorized to inflict, but not sufficient to require trial by a general court-martial. Commissioned and warrant officers are tried by general court-martial only.

General courts-martial may be convened by the President, by the Secretary of the Navy, by the commander in chief of a fleet or squadron, and by the commanding officer of any station beyond the continental limits of the United States. No commander of a vessel shall inflict upon a commissioned or warrant officer any other punishment than private reprimand, suspension from duty, arrest, or confinement, and such suspension, arrest, or confinement shall not continue longer than 10 days, unless a further period is necessary to bring offender to trial by a court-martial. When a court-martial is ordered by the Secretary of the Navy, the necessary orders convening the court-martial shall be prepared in the office of the Judge Advocate General.

"Desertion," as distinct from "absence without leave" and "absence over leave," is defined as unauthorized absence with specific

intent permanently to abandon the naval service or cancel the pending contract. In the case of "absence without leave," if the intention of the absentee is not clearly manifest, at the end of 10 days he is declared a deserter and action is taken. In the case of "absence over leave," if the absentee does not communicate with his commanding officer, at the end of 10 days he is declared a deserter and action is taken. In case of desertion from duty, the desertion dates from the time the man leaves his duty; if from leave, the desertion dates from the time the leave expires.

A reward may be offered by the commanding officer for the apprehension of an enlisted man if he has been declared a deserter, the amount not to exceed $50, which shall be checked against his accounts. A reward for the apprehension of an officer shall not be offered unless specifically authorized by the Navy Department, or on a foreign station by the commander in chief.

In time of war, any person who deserts the naval service of the United States shall, upon conviction thereof, be forever incapable of holding any office of trust or profit under the United States or of exercising any rights of citizenship thereof, but this does not apply in time of peace. The wages due a deserter are forfeited to the United States.

The Marine Corps shall at all times be subject to the laws and regulations established for the government of the Navy, except when detached for service with the Army by order of the President; and when so detached they shall be subject to the rules and articles of war prescribed for the government of the Army. The marines are subject to duty either afloat or ashore. The Major General Commandant of the Marine Corps is stationed at the headquarters of the Marine Corps, Washington, D. C., and he is responsible to the Secretary of the Navy for the efficiency and discipline of the corps.

Each person on the active list of the Navy or Marine Corps is allowed to allot such portion of his pay as he may desire for the support of his family or other relatives, for his own savings, or for other proper purposes. Each person on the retired list of the Navy or Marine Corps is allowed to make allotments for the payment of premiums on insurance and for Navy mutual aid assessments, but for no other purpose.

Active and retired nurses, who are stationed or live in the immediate vicinity of the city where commissary stores are established, are authorized to make purchases from the commissary store.

Uniform regulations include all regulations and instructions relative to the uniform of all persons in the Navy and Marine Corps. The order promulgating these regulations is signed by the Secretary of the Navy, who also signs the orders for any changes that

may be made in them from time to time. All uniform regulations, or changes therein, for the Navy shall be prepared by the Bureau of Navigation, and for the Marine Corps, by the Major General Commandant of the corps.

All Navy regulations and all circulars directing changes therein shall be prepared in the office of the Chief of Naval Operations.

The Navy Department maintains no censorship on discussions or articles on professional subjects by persons belonging to the Navy. Nevertheless, unrestricted utterance or publication of fact and opinion may divulge information which it is not advisable to make public. Any communication intended for the public should be composed after mature reflection, in a spirit of good taste and temper, and in a seemly and proper manner. A signed copy of any article on professional subjects must be in the hands of the Navy Department at the time of publication of the communication. The author is responsible for the statements made. Praise or censure of other persons in the naval service is forbidden.

When official business is conducted by telephone or orally, the substance of any communication or order that should be made a matter of record shall be reduced to writing without unnecessary delay. No written communication shall be received as official which is not forwarded through the prescribed channels, and with the indorsement of the officer through whom forwarded. The sheets of a letter or report shall be arranged in regular order from bottom to top; that is, the first sheet on the bottom and the last sheet on top.

Upon receipt of orders requiring a nurse to proceed to any station when no date is fixed nor haste expressed, she shall report within four days, exclusive of travel time, after receipt of orders. If the orders read "without delay," she shall report within 48 hours, exclusive of travel time, after receipt; if "immediately," within 12 hours, exclusive of travel time, after receipt.

Application for the revocation or modification of orders shall be made in an official form and through official channels and shall state the precise reason for making the application. An application for the revocation or modification of orders to proceed will not justify any delay in their execution, if the officer ordered is able to travel; and no person shall delay obedience to orders for the purpose of making remonstrance or complaint.

The right of all officers, whether of the line or staff, to communicate with the commanding officer at all proper times and places is not to be denied or restricted.

An officer shall not, without authority from his commanding officer or superior, absent himself from his duty or exchange duty with another.

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Whenever an accusation is made against an officer, either by report or by indorsement upon a communication, a copy of such report or indorsement shall be furnished him at once.

An officer suspended from duty shall confine himself to the limits assigned him at the time of his suspension, or afterwards, and his failure to do so shall be regarded as a breach of arrest. An admonition or caution in the ordinary course of duty shall not be considered as a reprimand in the sense of punishment.

If any person in the Navy considers himself oppressed by his superior, or observes in him any misconduct, he shall not fail in his respectful bearing toward him, but shall represent such oppression or misconduct to the proper authority. He will be held accountable if his representations are found to be vexatious, frivolous, or false. An application for redress of wrong shall be made in writing through the immediate commanding officer to the proper authority and it shall be the duty of the latter to take such action in the matter as, in his judgment, justice and the good of the service demand.

A nurse is entitled to shipment of her household effects, up to a certain weight, at public expense, when being transferred from one station to another. Professional books used in the performance of official duties may be shipped at public expense, in addition to the gross weight allowed for household effects. Household effects shall comprise the personal belongings and household effects which are exclusively the property of the person ordered to make the change of station and which have been in use by such person (or his family) previous to shipment thereof. Automobiles may be included in shipment of baggage, but the actual weight of the automobile shall be charged against the authorized allowance. If excess weight or cost is involved, the automobile will be considered as the excess either in whole or in part. For nurses, who retire from the service, packing, crating, and transportation of houshold effects at public expense (within the allowance specified and within one year from the date of retirement) are authorized from last duty stations or places of storage to such places within the limits of the United States as may be designated by them as their homes. Should a nurse die in the service, provision is made for the shipment of her household effects.

Shipment of household effects is not authorized when a nurse is transferred from one station to another at her own request, such fact being shown in the orders. Packing, crating, and transportation of household effects at public expense is not authorized when a nurse is ordered home for release from the service. Damage to or loss of household effects in transit, whether shipped by a supply officer or by the owner, is a matter for adjustment by the owner of the effects with the carrier, as household effects are not Government property.

# NOTES AND COMMENTS

## LETTERS OF COMMENDATION

In accordance with the statement made in the preface of the BULLETIN, the Surgeon General of the Navy appointed a board to select the papers published in the BULLETIN during the year 1927 which it considered to be worthy of letters of commendation. As a result of the selections made by the board, letters of commendation have been sent to the officers named below for the papers which appear opposite their names.

Commander C. W. O. Bunker, Medical Corps, United States Navy—"Medicine in Turkey."

Lieut. Commander J. Harper, Medical Corps, United States Navy—"Dressing Sterilizers with Special Reference to Temperature, Pressure, and Chamber Air Exhaustion During the Process of Sterilization."

Commander L. W. Johnson, Medical Corps, United States Navy—"Abdominal Wounds and Injuries."

Commander W. L. Mann, Medical Corps, United States Navy—"Medical Tactics in Naval Warfare."

Lieut. Commander R. B. Miller, Medical Corps, United States Navy—"Some Observations on Avoidable Drowning."

Lieut. G. E. Mott, Medical Corps, United States Navy—"Posture."

## CORRECTIONS

In the paper on Chinese Military Medicine, by Lieut. (Junior Grade) J. L. McCartney, Medical Corps, United States Naval Reserve, which was published in the October, 1927, number of the BULLETIN, part of one paragraph on page 794 reads as follows:

> * * * An investigation of Chinese drugs is not altogether fruitless. For instance, in cases of dropsy the Chinese have long used a medicine called "Ma Huang" which they obtain from the skins of toads. It has been discovered that the skins of certain species of toads yield powerful substances such as bufagin, bufotalin, and bufotoxin; that bufagin is really efficacious in dropsy, and that research workers recently have prepared ephedrine from Ma Huang, which has an action similar to that of adrenalin * * *

It is well known, of course, that ephedrine is prepared from the plant *Ephedra vulgaris* and other allied species and that Ma Huang is the native name for a Chinese variety of *Ephedra vulgaris*.

The author tells us that the sentence which states that Ma Huang is obtained from the skins of toads was made to read as it does by an error on the part of his Chinese typist, who left out part of a sentence, and that, because of the disturbed state of affairs in China at the time, which necessitated the author's leaving that country, he was unable to read the copy with the care he would have liked to give it.

The paragraph quoted above should have read:

* * * An investigation of Chinese drugs is not altogether fruitless. For instance, in cases of dropsy the Chinese have long used a medicine called "Ma Huang." *They also use a preparation* which they obtain from the skins of toads. It has been discovered, etc. (Italics denote portion of sentence accidentally left out.—*Ed.*)

In the article "Acute gingivitis associated with fusiform bacilli and spiral forms," by Commander C. H. Mack, Dental Corps, United States Navy, which was published in the January, 1928, number of the BULLETIN, the author stated, on page 51, that "the clinical advantage of cold as an aid to treatment has not been mentioned in the literature." After writing his paper, but too late to have correction made therein, the author found in the Dental Cosmos, LXV: 11 (Nov.) 1923, mention of a paper by V. Jelinek, published in the May 31, 1923, number of the Wiener Klinische Wochenschrift and abstracted in the Journal of the American Medical Association, September 22, 1923, in which Jelinek reports having used ethyl chloride in 1919 and 1920 for the same purpose as that for which it was suggested in the BULLETIN article.

Commander Mack has requested that mention be made of this, as he has no desire to have it appear that he is the originator of a method used eight years ago.

## UNDULANT FEVER

The memorandum which follows is submitted by the members of the "Camera Medica" of Malta and of the Malta branch of the British Medical Association. It is a plea for the discontinuance of the geographical designations of this disease and the general adoption of the name "undulant fever."

1. A suitable and generally acceptable designation of this fever has long been the subject of discussion. The disease is one of those that have been labeled with a multitude of names; 13 appellations have been given to it on account of its supposed resemblance to typhoid or malaria; the character of its fever and the symptoms it presents gave rise to 14 other designations, and 9 more were derived from the conditions which from time to time were considered to favor its prevalence. From the localities in which it was recognized and studied it came to be called Mediterranean fever, Malta fever, Italian fever, Neapolitan fever, Rock of Gibraltar fever, Cyprus fever, Crimean fever, etc.

2. The name "undulant fever" originally proposed by Capt. M. L. Hughes, Army medical staff, in 1897, was recommended by the International Congress of Medicine held in London in 1913, and is the one generally used by English writers. The terms "Malta" or "Mediterranean fever," however, are still frequently met with, and the purpose of this communication is to point out the objections to the use of these appellations and to make an earnest appeal to all medical and scientific writers to discard them in favor of the more proper and less controversial one—undulant fever.

3. The term "undulant fever," though not perfect, is the most suitable designation of this disease in the present circumstances. As Hughes has pointed out, it describes one of the most constant and characteristic features of the disease, namely, the undulations of the temperature curve. The temperature constitutes the primary, in many cases the only, clinical manifestation of the illness; and although the curve may not always be of the "undulant" type, yet the phenomenon is sufficiently frequent and typical to justify the adoption of the word "undulant" as a term which would clearly convey to any person the principal clinical feature of the disease. Parallel cases are the designation "typhoid fever," in general use for the disease in which the "typhoid" state is a frequent and salient but not constant symptom—and even more so the term "relapsing fever," derived solely from the variations of the temperature.

4. The term "undulant" has so far been used only for this disease; it can not therefore give rise to ambiguity and does not offer the same drawbacks as the term "remittent" and "intermittent." Hughes had also rightly claimed that it "has a familiar sound, slips easily and lightly from the tongue, and is easily translatable into any language from the Latin form of febris undulans." Its use has been accepted by many authorities whose attention has been called to the matter and is continually gaining favor with scientific writers. It appears in fact to have stood the test of time, and once that, excepting the objectionable geographical names, no other term has been more frequently used as a designation of this disease, the coining of a new name does not appear to be opportune at present.

5. It is agreed that geographical names given to specific diseases are undesirable from a scientific point of view. They are mainly relics of the times when the miasmatic theory of disease held sway and each kind of fever was considered to be caused by "infective emanations" inherent to the particular country or locality where it prevailed. They have no relation whatever to the symptomatology of a disease, or to any of its primary or secondary features, and are neither characteristic nor significant of its nature. As Sir William Aitken said when advocating the use of a general nomenclature of diseases: "Except as matters of history and as beacons to warn us from a greater danger to science, let these and such like names be consigned to oblivion." And, as a matter of fact, the disease which forms the subject of this communication appears to be one of the very few for which a geographical name is still in use.

6. A consideration of the history of fevers for the last 150 years brings home very clearly the part which the use of geographical names played in helping to retard progress in the unraveling of the nosology and etiology of diseases. This is specially evident in connection with the "Mediterranean" group of fevers. Under such names were frequently grouped together indiscriminately such diverse diseases as typhus and typhoid, yellow fever, another fever accompanied by jaundice of doubtful nature, sandfly fever, relapsing fever, and probably malarial cases and other feverish diseases which are still unclassified.

7. The name "Malta fever" was eventually assigned to the long-continued fever of the undulant type comparatively recently. Formerly by "Malta fever" or "Maltese fever" was understood the "simple ardent fever" of short duration now known as phlebotomus fever. Marston, who was the first to give a detailed description of undulant fever in Malta (Army Medical Report, 1863), called the disease "Mediterranean or gastric remittent fever" and clearly differentiated it from "simple ardent fever," which he continued to call "Maltese fever." Boileau (1866) described "Malta fever" as "a pyrexia with sudden onset terminated in seven days by lysis." Later on the term came to be applied also to fevers of longer duration. (Maclean, Wood, Notter, 1876.)

It is evident, therefore, that the designation "Malta fever" can not be retained for the fever of the undulant type on the plea of length or priority of use.

8. The fact that undulant fever is not confined to the island of Malta or to the Mediterranean needs hardly to be emphasized. It has been identified in other European regions and in widely separated localities in China and America, South Africa and India, etc. Nor, it may be mentioned, is it peculiar to the Maltese goats.

9. Recent observations that the *B. abortus* of Bang may give rise to a continued fever of the undulant type similar clinically to that caused by the *M. melitensis* of Bruce would furnish a further argument against the retention of the term "Malta fever." Whatever connection there may be between the designations "Malta fever" and *M. melitensis*, it does not hold good when the fever is due to the *B. abortus*. The adoption of the term "undulant fever" for the clinical condition, followed in each case by an indication of the causative agent, e. g., undulant fever (Bruce), undulant fever (Bang), should prove useful, as in the case of the paratyphoids.

10. The prejudice to the moral and material interests of the island of Malta in consequence of the association of its name with a disease which is far from being peculiar or limited to the locality is considerable. The Maltese nation keenly resents the resulting stigma and feels that the reputation of their country has suffered mainly on account of the important research work on the disease that has been carried out in the island. The Government of Malta, in fact, has on several occasions considered it necessary to make representations on the subject.

11. The members of the "Camera Medica" of Malta and of the Malta branch of the British Medical Association have ventured to submit the above observations in the hope that their fellow members of the medical and allied professions will take their request into sympathetic consideration and that they will accept their suggestion for the general adoption of the designation undulant fever and for definitely discarding the inappropriate geographical names.

## IRON MEN

"Iron men in wooden ships" is a term frequently applied to the Old Navy. While the term has nothing to do with medicine, it seems probable that some medical officers of the earlier days considered their patients "iron men." This statement is made as the result of reading some of the case records contained in the medical journal of the U. S. S. *Cumberland* for the years 1849 and 1850. One record,

which illustrates this very well and also shows the great difference in drug giving between those days and the present, is quoted. The patient was an ordinary seaman, aged 21 years, born in Ireland.

The record is as follows:

Nov. 10. Admitted with Hemorrhoid. External blind. Apply ointment of oxide of zinc.
16. Take Ol. Ricini f℥i. Attention to diet.
17. Oleaginous mixture hourly.
18. Nothing required.
20. Complains of abdominal pains. Took Oleag. Mixture yesterday. No evacuation for two days. Take Ol. Ricini f℥i
21. Ol. Terebinth. f℥i. The yolk of one egg, Acaciae ʒi. Tr. Menth. Pip. gtt. xx. Aqua f℥iv. M. and take a tablespoonful every two hours.
22. Somewhat better. Contin. mixture of yesterday.
24. No change. Take Turpentine Mixture hourly till it operates.
25. Take purgative of Ol. Ricini f℥i. Ol. Tereb. f℥ii.
26. Much the same, bowels not open freely. Take Ol. Tiglii gtt. ii followed by Ol. Ricini if necessary.
28. Improving Slowly. Repeat the Ol. Tiglii. Corn Meal diet.
29. Take Ol. Ricini f℥i.
30. Better. Bowels opened twice yesterday. Contin. Indian diet.

Dec. 1. Took a purgative of Ol. Ricini and terebenth.
2. Better to day, bowels freely open.
4. Improving slowly.
6. " " . Took purgative yesterday.
8. Has distinct fluctuation in the abdomen, the belly being swollen, tense, and acuminated at umbilicus. Take Pil. Hyd. grs. v. this morning and at night Pil. Hyd. and Ext. Coloc. Comp. aa. grs. xii.
10. No change. Contin. treat.
12. " " . " "
13. " " . Take Ol. Ricini f℥i.
14. Much the same, belly still swollen somewhat, pain in the lower part continues, with some tenderness to the touch. Bowels were opened twice yesterday. Take pills of Aloes and Gamboge daily until free purgation.
16. Feels better. Pills of yesterday did not operate. Repeat the dose.
17. Much the same. Complains of sore throat. Bowels still very torpid. Take half gr. of Elaterium b. d. and use Capsicum gargle.
19. Contin. pills of Elaterium b. d.
20. No better. Still complains of pains over abdomen and of nausea. Bowels freely opened with greenish watery stools. Medicine still operating. Take one pill this afternoon.
21. Much the same. Has been purged very freely, and has still small watery stools. Take Jalap and Bitart. Potassa.
22. Feels rather better but still has the pains in the abdomen. Stools frequent, small and watery. Urine small in quantity and smells badly. Take Inf. Diosma q. 3. h. and Bitart. Potas. ℥i. t. d.
24. Much the same. Contin. Inf. and take Bitart Potassa. ℥ss. b. d.
26. " " " " " " Pills of Aloes and Gamboge.
28. Had one copious evacuation of hard substance yesterday, after which felt much better about the belly. This morning much the same again. Repeat the dose of pills of Aloes and Gamboge.

Dec. 29. Much the same. Take a purgative of Aloes, Gamboge and Elatium.
30. Felt worse during the day yesterday, with chilliness and general pains. Had one free evac. during the day. Complains this morning of much pain in the abdomen. Simple diet.

1850

Jany. 1. No change. Took Calomel followed by oil yesterday, which did not operate until night, and then with some griping. Take a diet of Barley gruel alone, with weak tea as a drink, morning and evening.
3. Feels somewhat better. Had 3 alvine evac. this morning which he compares in color and consistence to yolk of egg. Contin. exclusive Barley gruel diet.
5. Not so well as yesterday. Bowels not opened for 3 days. Take Inf. Senna and Manna q. 2. h. ad. op. Contin. Barley diet.
7. Much the same. Purgative infusion operated very well. Bowels open slightly this morning. Urine free. Contin. diet.
9. Better. Belly less swollen. Bowels open, and urine very copious and limpid. Contin. diet.
11. Still improving in every respect. Contin. diet.
13. Much the same, complains of palpitation and oppression at the chest, particularly when he lies upon his back. Contin. diet.
14. Take Inf. Senna and Manna.
15. Much the same. Complains of soreness and tenderness in the right iliac and hypogastric regions. Bowels freely opened yesterday the first passage being of hard scyballa. Take Calomel gr. i. Squill powd. gr. ii. in pill twice a day.
17. Much the same. Complains much of soreness and tenderness over the lower part of the abdomen, and occasional severe pain in the back.—Cannot bear to strain any at stool from the pain it gives him in the lower part of the belly. Contin. Calomel and Squill b. d.
18. Take Inf. Senna and Manna until it operates.
19. Much the same. Resume Calomel and Squill as before.
21. " " ". Complains of retention of urine and pain in the region of the bladder. Drew off urine. Take Inf. Senna and Manna as before.
22. Feels better today. Contin. purgative infusion.
23. Much the same. Bowels freely opened, urine free. Resume pills.
25. " " ". Contin. Calomel and Squills.
26. " " ". Retention of Urine requiring Catheter. Contin.
27. " " ". Inf. Senna and Manna ad. op.
29. " " ". Bowels opened freely.
30. Had an attack of nervous dyspnoea last evening. Took Assafoetida and Tr. Opium. Take 5 grs. Iod. Potas. in f i of Comp. Syr. Sarsap. 3 times a day.
31. Was threatened with another attack of dyspnoea last evening and repeated the dose of antispasmodics, in other respects is much the same. Contin. Alteratives.

Feby. 2. Much the same. Contin. Alteratives.
4. No material change except that his bowels are now more regularly open. Contin. treat.
6. Feels slightly better. Contin. treat.
8. Not so well today. " "
9. Much the same. Bowels costive with pain. Inf. Senna. p. c.
10. Feels slightly better about the belly, bowels open.

Feby. 12. Much the same. Bowels Constipated. Resumed Alter. yesterday.
13. Not so well, bowels constipated. Inf. Senna and Manna as well as the syrup losing their aperient effect. Inf. Senna and Salts.
14. Slightly better again. Bowels Open.
16. No change. Complains of pains in the lower part of the abdomen chiefly. Resumed alterative yesterday.
18. No Material Change. Passed very large quantity of urine which exhibits no albumen by heating. Contin. Alteratives.
20. Had an enema yesterday which operated slightly. Feels much the same. Alteratives Contin[d]. Enema repeated.
22. Much the same. Complains of pain in the bladder and penis, with obstruction in passing water. Contin. alteratives.
23. No Material Change. Contin. Alteratives. Repeat Enema.
24. Belly more tender and swollen. Had a small stool of scibulous matters after enema. Contin. treat. and repeat enema.
25. Much the same. Bladder irritable, urine scanty, and retained long. Take Inf. Uva Ursi. t. d.
27. No material change. Contin. Inf. Repeat enema.
28. " " " " " examine urine.

Mar. 2. Was worse last night, considerable pain and distension of the abdomen, particularly in right iliac region. Sinapism to seat of pain and two doses 10 drops each of Black drop. Somewhat better this morning. Flaxseed tea as a drink.
4. Much the same. Took Flaxseed tea and Bitart Potassa since yesterday.
6. Somewhat better. Contin. treat. Bowels open daily.
8. Much the same. Take Spts. of Nitre t. d. and Inf. Lini as before.
10. " " ". Contin treat.
12. Abdomen more flaccid. Bowels freely open. Flaxseed tea ad. lib.
14. Much the same, complains much of pain in the region of the bladder. Stoppage in passing water, and scalding in the urethra. Bowels Costive. Rhubarb and Magnesia. Flaxseed inf.
16. No change. Complains much of pains and soreness over abdomen and back, and of scalding in passing his urine. Take 5 grs. Nit. Potassa t. d. and contin. Flaxseed tea.
18. No material change. Still complaining of Penis and bladder. Sounded bladder, but discovered nothing, bowels costive. Take Rhubarb and Magnesia.
20. No material change. Not so much pain in Penis. Resumed Nit. Potassa yesterday. Double the dose and Contin. Inf. Lini.
22. Somewhat better in many respects. Bowels opened by Inf. Senna and Salts yesterday. Resume Nit. Potassa as before.
24. No material change. Contin. treatment.
25. Feels much better in all respects. Contin. treat.
28. Much the same. Increase dose of Nit. Potassa to 15 grs. t. d. Inf. Lini.
30. Feels worse this morning; passed some large masses of very hard faeces yesterday, and a large quantity of urine. Complains of pains in groins and abdomen. Continue treatment.

April 1. Much the same. Urine more free, and smells badly. Bowels constipated and some pain. Take Inf. Senna and Salts.
3. No material change, Complains much of pains in urinating. Had some hardened alvine evac. yesterday, pains in abdomen, not so bad. Take Cal. gr. i. Opium gr. ⅙ in pill t. d. Contin. Inf. Lini.

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| April | 5. | Much the same. Passes water with difficulty, bowels constipated. Take Inf. Senna and Salts. |
| | 7. | No material change. Contin. Calomel and Opium. |
| | 8. | " " " . Inf. Senna and Salts. |
| | 9. | " " " . Resume Calomel and Opium. |
| | 11. | " " " . Take ʒss. Potas. Tart: t. d. |
| | 13. | " " " . " " " ". |
| | 17. | " " " . Infus. Senna and Salts. |
| | 19. | " " " . Resumed Potas. Tart yesterday. |
| May | 20. | Transferred to S. S. Erie for passage home, by recommendation of survey of April 13th. |

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## AN INSTANCE OF SECOND INFECTION WITH SYPHILIS

What seems to be a definite case of second infection with the *Treponema pallidum* has recently come to the attention of the bureau.

H. S. E., S. K., first class, United States Navy, was admitted to the sick list with syphilis on February 7, 1924. At that time it was recorded that there were general glandular enlargement and secondaries—presumably a skin rash—and the Wassermann reaction was 4+. Hence there can be no doubt of the correctness of the diagnosis.

From the time of admission until July 9, 1926, the patient received 32 injections of neoarsphenamine and a commensurate amount of mercury salicylate, in four courses.

After this treatment the Wassermann reaction on the patient's blood was negative.

On September 10, 1927, this man was again admitted to the sick list on the ship to which he was attached at the time. This time no definite diagnosis was made, but syphilis was suspected.

There was a large indurated sore posterior to the corona and another sore on the trunk of the penis. He gave a history of exposure to infection during the latter part of July. The sore was noted 12 or 14 days later.

Six dark-field examinations of serum from the ulcer were made and all were negative for *T. pallidum*.

On the same day he was admitted to the sick list he was transferred to the naval hospital at San Diego, where another dark-field examination was made and reported negative. Here he was started upon injections of neoarsphenamine and, on September 20, 1927, the diagnosis of syphilis was made. The lesion was described by the medical officer as being "typically a hard chancre." It was also stated that it did not occur on the site of the previous sore.

The patient was notified that he had been admitted to the sick list as a result of his own misconduct, and he did not wish to make a statement in rebuttal.

On the 30th of September the Kahn test was reported as 4+. On this date he was returned to duty with the sores healed and no rash in evidence.

On the 8th of December the patient was readmitted to the sick list at the naval dispensary, Pensacola, with the diagnosis of syphilis. This time he made a statement in rebuttal of the misconduct status, which was, in effect, that he did not believe he had ever been cured of the 1924 infection and that the disease was "still hanging on." He, therefore, thought that he was entitled to pay while on the sick list.

At this time mucous patches were present in his mouth and his blood Wassermann test was reported as 4+. Definite palpable inguinal and epitrochlear glands were present. He was on this date transferred to the naval hospital at Pensacola.

Here, the commanding officer agreed with the medical officer of the dispensary that the condition was not a return of the 1924 infection, but that the patient was suffering from syphilis probably contracted when he was exposed during the latter part of July, 1927.

The papers in the case were then forwarded to Washington for a determination of the question of "misconduct."

The record in the case was submitted to Capt. C. S. Butler, Medical Corps, United States Navy, for an expression of opinion as to the likelihood of this being a recrudescence of the disease which was contracted in 1924.

Captain Butler, in reply, stated that the lesion which was noted on September 10, 1927, might have been (1) a chancre, indicating a reinfection with syphilis; (2) an allergic reaction from the 1924 infection with syphilis; or (3) a chancroid.

He further said that the thorough course of treatment which was given after the 1924 infection and the negative blood test which followed it suggest strongly that the patient was cured of this infection.

As evidence that it was not an allergic reaction, Captain Butler calls attention to the fact that no "explosive inflammatory reaction with necrosis (umstimmung)" occurred, but that a typical chancre developed, and this not at the site of the original infection. Furthermore, the 1927 lesion was followed, after the proper intervals of time, by the secondary symptoms of syphilis.

The failure to find the treponema by dark-field examination was not considered remarkable by Captain Butler, in view of the large percentage of cases in which it was missed by British and other authorities during the World War.

His conclusion was that this was "a well-proved instance of second infection with syphilis."

The Bureau of Medicine and Surgery concurred in this opinion and the papers were forwarded to the Judge Advocate General, who

decided that for the purpose of determining the pay status of this man, the initial symptoms of the disability from which he is suffering should be held to have appeared September 10, 1927.

The Secretary of the Navy approved the decision.

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## TURNER INDEX VERSUS SCHNEIDER INDEX

The Schneider index of circulatory efficiency is used routinely in the Navy in examinations for aviation duty. The method for determining the index is described in paragraph 1565 of the Manual of the Medical Department, United States Navy, 1927.

Recently, A. H. Turner has described, in the May and June, 1927, numbers of the American Journal of Physiology, a similar index based upon slightly different criteria.

Lieut. Commander J. R. Poppen, Medical Corps, United States Navy, instructor in aviation medicine at the Naval Medical School, has made a comparative study of the two methods, based upon only a small number of examinations (20), and has made a report concerning them, the substance of which follows.

Schneider assigns numerical values to variations in response to change in posture and a standard exercise, as indicated by the pulse rate and systolic blood pressure. Efficiency is indicated by slow pulse rate (prone, standing, and after exercise), slight increase on standing and after exercise, and a rise in systolic pressure in the standing position.

Turner assigns values to the same variations, but prescribes a different exercise and includes additional variables. She obtains the basic pulse rate and blood pressure readings while the subject is in the prone position. He then rises quickly and remains standing quietly for 15 minutes, during which time pulse and blood pressure readings are taken at three-minute intervals.

Turner also considers the general course of the pulse rate, systolic pressure, and diastolic pressure, during prolonged standing, and the change in diastolic and pulse pressure on changing from the prone position to the standing position.

The maximum rating in both indices is the same—18.

In the small series of examinations made at the Naval Medical School by both methods, 75 per cent showed variations of 4 or less, and in the cases where wider variations occurred these could be explained by extraneous influences.

The conclusion reached by Doctor Poppen is that the Turner index does not appear to be a desirable substitute for the Schneider index for the following reasons:

1. The strain on the circulation is not sufficient. Standing to attention is a customary exertion in military organizations and for 15 minutes constitutes practically no strain. (Turner's tests were upon "24 healthy young women.")

2. It is too time consuming. In the prone position, "12 to 15 minutes were usually sufficient for the securing of two successive sets of readings practically alike." Standing is prolonged for an additional 15 minutes. The Schneider index can usually be completed in 10 minutes.

3. Scoring is too difficult. As compared to the simple chart for the Schneider index, the Turner index is calculated on a very elaborate table. Cognizance is taken of whether or not the course during standing shows "fluctuation," "variation," or "increasing or decreasing tendencies." "Plotting the determination is essential for getting a picture of the progress of the various changes."

4. It is too elaborate for practical use.

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## CLINICAL EVALUATION OF CHOLECYSTOGRAPHY

Under the heading, "A clinical evaluation of cholecystography by the oral administration of tetraiodophenolphthalein," J. H. King, M. D., and Lay Martin, M. D., of the department of medicine, Johns Hopkins University, report, in the Bulletin of the Johns Hopkins Hospital, October, 1927, the results obtained by them in a series of 407 varied cases.

In all cases the dye was given by mouth in twelve 5-grain gelatin capsules, and plates were taken at 16, 19, and 22 hours. Between the second and third plates a meal containing fats was given.

The cases were grouped under two headings: 1, Patients operated upon (62), and, 2, patients not operated upon (313). A number of cases were eliminated from the series for various reasons.

Of the patients not operated upon, 142 showed no clinical evidence of gall-bladder disease, while 171 had definite signs. The authors consider the group (142) not having signs of gall-bladder disease, controls. Of these, the X ray showed that in 69.7 per cent the gall bladder was functioning normally; in 9.8 per cent, abnormally; and in 20.5 per cent it did not fill at all. This group was made up of patients with visceroptosis, mucous colitis, duodenal ulcer, chronic appendicitis, nephrolithiasis, migraine, obesity, and neurosis.

Among the group with undoubted gall-bladder disease (171), 34.5 per cent showed normal functioning of the gall bladder; 22.9 per cent showed abnormal function; and no dye was found in the gall bladder in 42.5 per cent.

As the authors remark: "The most striking feature of the results in these two groups is that 20.5 per cent of the patients considered to have clinically no biliary disease showed no filling of the gall bladder with the dye, whereas 34.5 per cent of these patients who were thought to have biliary disease showed a normally functioning

gall bladder by the Graham test. Many in this group had jaundice, gall-bladder colic, or both."

Of the 62 patients operated upon, 55 gave clinical evidence of gall-bladder disease, which led to the operation, while 7 were operated upon because of other conditions.

Of this group, 20 cases showed a normal function; 6 cases, an abnormal function; and in 36 cases there was no filling of the gall bladder with the dye.

Of the 20 cases showing a normal function, 11 showed a normal gall bladder at operation, while in 9 cases gall stones were found. The Graham test was found to be correct in 11 cases (55 per cent). The clinical diagnosis was correct in 18 out of 20 cases (90 per cent).

In all of the 6 cases showing abnormal function of the gall bladder, a diseased gall bladder was found at operation.

No dye was seen in the gall bladder in 36 cases, and, of these, 30 showed a diseased gall bladder at operation.

As a result of their findings in this series of cases, King and Martin conclude that:

> The Graham dye test attempts to determine whether, or not, the gall bladder is exercising its normal functions. Our studies have shown that while the method is an aid in diagnosing diseases of the gall bladder, it has certain limitations.
>
> 1. It will not give positive assurance that a normally functioning gall bladder is organically normal. It may give misleading information.
>
> 2. If the gall bladder fills and empties normally with the dye, the resultant picture need not necessarily depend upon the method of administering the dye. A satisfactory film has been obtained. However, in our series of patients who were operated upon, and who showed by the dye test a normally functioning gall bladder, 9 out of the 20 were found to have a diseased gall bladder. Hence it is fair to conclude that there is a probability of error in diagnosing a gall bladder as normal, whether the dye be given intravenously or by mouth.
>
> 3. In the nonfilling gall bladders it will not always assure the clinician that a gall bladder is diseased, although this possibility of error is less (20 per cent).
>
> 4. A so-called delayed filling of the gall bladder can not be taken as evidence of early gall-bladder disease or, for that matter, of any disease. It was seen in many of our control cases; i. e., they showed greater concentration in the second (19-hour) film.
>
> 5. The number of stones demonstrated by the X ray after dye administration is decidedly greater than without it.
>
> 6. The evidence afforded by the Graham dye test must be carefully compared with the information gained from clinical studies of the cases under consideration. It is helpful but not absolute.

## TOXEMIAS OF PREGNANCY

The etiology of the toxemias of pregnancy has never been satisfactorily determined and the search for a cause still continues. In a special report of the Medical Research Council, published by His

Majesty's Stationery Office, London, devoted to a clinical and biochemical study of the toxemias of pregnancy, by J. N. Cruickshank, J. Hewitt, and K. L. Couper, of the Glasgow Royal Maternity and Women's Hospital, a valuable section deals with etiology and throws much light upon the subject.

Three facts which must be kept in mind in any discussion of eclampsia are stated by the authors to be:

1. True eclampsia * * * does not occur spontaneously in animals.

2. True eclampsia has not been reproduced in its entirety experimentally in animals, but certain features of it can be closely simulated if not actually reproduced by the experimental injection of various substances including tissue extracts and, more particularly, placental extracts.

3. Eclampsia and the allied forms of toxemia are essentially associated with pregnancy and do not occur apart from it. No experimental condition can be regarded as identical with them unless it is produced in pregnant animals and unless it fails to appear when nonpregnant animals are subjected to similar conditions.

There is no evidence to suggest animal or vegetable parasites or disturbance of the endocrine glands as causes of eclampsia.

Possible sources for the toxic factor or factors are stated to be (1) the fetus, (2) the placenta, and (3) disturbance of the maternal metabolism. These are discussed by the writers who, in concluding their report, say:

The results of our own clinical and chemical observations and the evidence supplied by the work of others lead us to the conclusion that if the toxemias of pregnancy have a common cause it is some form of intoxication by the breakdown products of placental tissue, probably some of the higher products of protein katabolism which, like the breakdown products of lecithin, have a powerful action even when present in small amount.

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### CARE OF LABORATORY ANIMALS

Science (November 25, 1927) publishes a short paper by Heman Ibsen, of the Kansas Agricultural Experiment Station, which treats of matters of much importance to hospitals and laboratories, "snuffles" in rabbits and pneumonia in guinea pigs.

These two diseases are the cause of great mortality among laboratory animals. Any simple method of preventing them should be welcomed by those who have to see that a supply of animals is always on hand as well as by those whose duty it is to care for the animals.

Ibsen says that "snuffles" does not occur in rabbits which are kept in open-air hutches in which they are exposed to direct sunlight. The ultraviolet rays prevent the development of the disease. It is necessary, however, for most breeders and laboratories to keep their animals housed, at least during the winter months. For these it is important that "artificial sunlight" be supplied. This is done by

feeding cod-liver oil. The writer has found that 2 per cent of cod-liver oil fed with the grain ration produces the same effect as direct sunlight. If the animal has already become too weak to eat, a few cubic centimeters of the pure oil may be administered with a medicine dropper.

The vitamin D content of the oil is the agent of value. The oil also contains vitamin A, but this is not so important, as it is contained in sufficient quantity in the alfalfa hay which is fed the rabbits.

Ibsen has also found that the addition of oil to the grain ration of guinea pigs reduces the incidence of pneumonia greatly.

Sprouted oats contain enough vitamin C to prevent scurvy, but not enough vitamin D to prevent pneumonia. Green alfalfa, on the other hand, renders guinea pigs practically immune to pneumonia. It may be that green alfalfa is lacking in vitamin D, but if so it may contain some other substance which acts as a substitute and builds up a resistance to "snuffles" and pneumonia.

## A NEW GERMICIDE

A new liquid germicide, S. T. 37, is reported and discussed in Science for November 18, 1927.

S. T. 37 is a liquid germicide developed by Leonard and Feirer, of the Johns Hopkins School of Hygiene and Public Health. It is said that it destroys bacteria so quickly that the time taken to do so can not be accurately measured. It kills the most resistant bacteria in 15 seconds without injuring the most delicate tissues.

The active principle of S. T. 37 is hexylresorcinol, which was developed by Leonard about three years ago, and which was commented upon extensively in the Bulletin in April, 1926. At that time it was shown that the activity of hexylresorcinol was dependent upon the surface tension of the fluid in which it acted. With this in mind, Leonard has been searching for a suitable solvent for hexylresorcinol. He believes he has now found it in glycerin diluted with water.

Leonard shows that pure water has such a high surface tension—77 dynes—that it will not readily penetrate spaces into which a solution with a lower surface tension will go with ease. S. T. 37 has a surface tension of only 37 dynes—hence its name—and is, therefore, very penetrating. It comes into contact with germs which may be hiding in microscopical spaces.

Further, Leonard says, the low surface tension of the germicide hastens the destruction of the germ by mechanical adsorption, the power that chemicals which lower the surface tension of their solutions possess of concentrating rapidly on the surface of any non-

crystalline particles with which they come in contact. Hexylresorcinol possesses this power in a marked degree, so, when S. T. 37 comes in contact with germs, which are tiny, noncrystalline particles, hexylresorcinol becomes concentrated on their surfaces. The germicide actually seeks out the germs and then destroys them.

## PROGRESS IN SYPHILIS—1926

During 1926 a large number of articles on the subject of syphilis were published in the medical journals. These have been reviewed by Austin W. Cheever, M. D., and a summary of them, prepared by him, was given in the Boston Medical and Surgical Journal, November 24, 1927. As syphilis is a subject of such vast importance to the service, an abstract of Cheever's valuable summary seems worthwhile.

Comparatively little was written in 1926 about the use of bismuth in syphilis, because the indications for its use have become well established. Tryparsamide and malarial therapy in neurosyphilis received much attention. Much advance has been made in the serology of syphilis. A microscopical slide test for syphilis, using Kahn's antigen, has been worked out by Kline and Young (*J. A. M. A.*, 86: 928, March 27, 1926) and has been found to agree closely in its results with the Kahn and Wassermann tests. It has the advantages of greater simplicity, being more easily read, and of requiring less apparatus and serum.

Kline, Littman, and Mill (*Am. J. Syph.*, 10: 636, October, 1926) found, in a study of over 2,000 microscopic slide tests, close agreement with the Kahn and Wassermann tests, as well as with the clinical condition of the patients.

W. A. Hinton (*Boston M. and S. J.*, January 7, 1926) found the Kahn test especially valuable in testing hemolyzed specimens, but thought it erred on the side of the false positive.

S. Greenbaum (*J. A. M. A.*, 86: 1273, April 24, 1926) found that the Kahn and Kolmer tests agreed in from 96 to 97 per cent of cases. He advised that both be used.

Rosen and Drasnow (*Arch. Dermat. and Syph.*, 13: 506, April, 1926) studied the blood cholesterol in syphilitics and found it low in 100 per cent of a group of patients with untreated primary syphilis; in 50 per cent of untreated secondary cases; and in 25 per cent of untreated tertiary cases. After treatment, the cholesterol returned to normal in all primary cases and in most of the others.

The danger of contracting syphilis from the cadaver was brought to the attention by an editorial in the Journal of the American Medical Association, May 29, 1926.

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Wassermann tests with the serum from primary lesions were found unsatisfactory by Milan Kitchevatz (*Ann. de dermat. et syph.*, 7:332, June, 1926.)

The colloidal benzine test is considered superior to the colloidal gold test, especially for differentiating general paresis from other forms of neurosyphilis, by E. D. Osborne (*Arch. Dermat. and Syph.*, November, 1925).

The effect of heat on the development of experimental syphilis in rabbits has been studied by Schamberg and Rule (*Arch. Dermat. and Syph.*, 14:243, September, 1926), who found that it could be prevented by giving the rabbits a series of baths at a temperature of 113° F. within three or four days after inoculation. The authors believe that it does not necessarily follow that the same will hold for humans.

Pearce and Van Allen (*J. Exper. Med.*, 43:297, 1926) found that total thyroidectomy made the disease in rabbits inoculated with *Spirocheta pallida* more severe, while in partially thyroidectomized animals it was milder. They conclude that the endocrines have a part in the mechanism of defense against syphilis.

The testes from 40 syphilitic subjects were studied microscopically by Eli R. Saleeby (*Am. J. Syph.*, 10:215, April, 1926). Of these, 23 showed syphilitic changes, but in all cases but 1—a seven months' fetus—Levaditi preparations were negative.

Syphilophobia has increased greatly because of the widespread propaganda against venereal disease. Laboratory tests are accepted by many as infallible proof of infection. This leads to many unnecessary tragedies and worries. That this should not be is shown by J. H. Mitchell (*J. A. M. A.*, 87:1351, October 23, 1926).

That pregnancy develops a protection against infection by the spirochete is believed by H. C. Solomon (*Am. J. Syph.*, 10:96, January, 1926).

That skin involvement in late spyhilis and disease of the central nervous system are not incompatible is shown by Prokoptschuk (*Arch f. Dermat. u. Syph.*, 150:261, May, 1926), who found skin or bone disease in 10.32 per cent of cases of syphilis of the nervous system.

O'Leary, Goeckerman, and Parker (*Arch. Dermat. and Syph.*, 13:301, March, 1926) report that 25 per cent of a group of paretics were so improved by treatment with malaria as to be able to return to their former occupations. Arsphenamine, tryparsamide, or mercury, given immediately after the malaria, caused relapse.

Bosch and Mo (*Semana med.*, 1:25, January 7, 1926) found that 17 per cent of their patients with general paresis who were treated with malaria have been able to return to their business for at least

two years; 30 per cent have returned to ordinary home life; 21 per cent failed to show benefit. M. Nonne (*Med. Klin.*, 21, 1829, 1925) secured good results in about 30 per cent of 450 cases of paresis and 30 cases of tabes. Tabes was not much influenced.

Various writers, Cheney and Warner (*The State Hospital Quarterly*, 11:603, 1926), Driver, Gammel, and Karnash (*J. A. M. A.*, 87:1821, November 27, 1926), L. M. Green (*The State Hospital Quarterly*, 11:618, 1926), G. H. Kirby (*ibid.*, 11:559, 1926), David Cochran (*ibid.*, 11,587, 1926), Adelheim (*Urol. and Cutan. Rev.*, August, 1926), and Wagner-Jauregg (*Wien. med. Wchnschr.*, July 17, 1926) are all enthusiastic about the use of malaria in paresis, but most of them advise care in the selection of patients. Wagner-Jauregg uses relapsing fever in patients too weak for malarial inoculation, and Solomon, Berk, Theiler, and Clay (*Arch. Int. Med.*, 38:391, Sept., 1926) have used sodoku in a small series of cases and think it has some advantages over malaria.

The treatment of syphilis by drugs received much attention during 1926, and Cheever has summarized many of the leading articles which dealt with this subject.

Voegtlin and Dyer (*U. S. P. H. S. Reports*, January 21, 1927) found that the minimum sterilization dose of all drugs of the arsphenamine group is the same in terms of absolute amount of arsenic in the form of arsphenamine intravenously. The ratio of maximum tolerated dose to minimum sterilization dose was found to be most favorable in the case of sulpharsphenamine, less so with neoarsphenamine, and least with arsphenamine.

Several authors have reported favorably on the use of asphenamine as a prophylactic after exposure to known syphilitics. R. L. Sutton (*Arch. Dermat. and Syph.*, 13:822, June, 1926) reported one failure in a woman who was given 0.45 gram neoarsphenamine 48 hours after exposure to a primary lesion.

The odor and taste of neoarsphenamine may be prevented if the patient will eat a wintergreen or clove wafer during the administration of the drug, according to John H. Stokes (*J. A. M. A.*, 86:840, March 26, 1926).

Stovarsol, by mouth, was studied by Beutl (*Dermat. Wchnschr.*, April 8, 1925) in seven primary cases. The results were unsatisfactory but were sufficiently good to lead the author to recommend the drug in cases in which arsphenamine can not be given. He advises against its use by the laity as a prophylactic. Poole (*Bull, Johns Hopkins Hosp.*, 38:242, 1926) advises further experimental study before stovarsol is used in human syphilis.

Tryparsamide was studied by O'Leary and Becker (*M. J. and Record*, March 3, 1926), Louis Berg (*Am. J. Syph.*, 10:261, April,

1926), and Cady and Alvis (*J. A. M. A.*, 86:184, January 16, 1926), all of whom stress the danger of its use in patients with optic involvement. The first-mentioned authors feel that tryparsamide does not offer so much hope in general paresis as malaria, while Berg found it helpful in more than 40 per cent of the neurosyphilitics treated by him.

Wild and Roberts (*Brit. M. J.*, 1:1076, June 26, 1926) investigated the absorption of mercurial ointments by the skin. They found that all mercurials in ointment base were absorbed to some extent. Up to 30 per cent, the amount of mercury absorbed was proportional to the amount in the ointment. Mercuric oxide was most readily absorbed, ammoniated mercury and mercury salicylate were next in order, and calomel came last. Metallic mercury was not absorbed so readily as the oxide, but could be used in greater concentration.

Cole, Farmer, and Miskdjian (*Arch. Dermat. and Syph.*, 13:219, February, 1926) found that no insoluble compound of bismuth was completely absorbed from muscle tissue into which it was injected. They consider the use of metallic bismuth and bismuth oleate dangerous, while the use of potassium bismuth tartrate is safe. They do not recommend bismuth salicylate.

Bismuth salicylate is eliminated largely through the urine; the rate of elimination is increased with increased dosage, so there is no cumulative effect; the toxicity is low; in therapeutic doses the lesions are rapidly freed of spirochetes, according to O. M. Gruhzit (*Arch. Dermat. and Syph.*, 13:195, February, 1926) who worked with rabbits.

That bismuth may be found in the spinal fluid of practically all patients treated with it intramuscularly, is asserted by B. Sparachio (*Riforma med.*, 42:989, October 18, 1926).

Sodium thiosulphate was found by F. K. Chen (*Brit. J. Dermat. and Syph.*, 28:20, 1926) to shorten the duration of 10 cases of exfoliative dermatitis following arsphenamine injections to nine days, whereas the average duration in 7 untreated cases was 36 days.

R. D. Herrold (*J. A. M. A.*, 86:413, February 6, 1926) used nonspecific protein as an adjunct to treatment of Wassermann-fast cases of latent syphilis and found that the blood became negative in every case.

Finally, Cheever's summary states that the ultra-violet light has been found beneficial by Ravant, Basch, and Lambling (*Ann. de Dermat. et Syph.*, August–September, 1925) as an adjunct in the treatment of syphilis. It has no direct effect upon symptoms or Wassermann reaction, but acts beneficially upon the general health of the patient.

## GOITER SURVEY IN UTAH

During the years 1924 and 1925 a goiter survey, which included the examination of 110,000 school children, was made in Utah. Practically the whole of the State was included in the survey. As Utah is a very large State, this area included sections having a great variety of climate, altitude, soil, and living conditions, and may, therefore, be considered as comprehensive.

The Utah State Board of Health has recently issued a report covering this survey, the summary of which is given.

(1) In Utah over 110,000 pupils and students have been examined for thyroid enlargement, that number being almost equally divided between the sexes.

(2) Thirty-two per cent of the males and 54.5 per cent of the females showed some degree of enlargement; almost all of the enlargements were of the "simple goiter type."

(3) Of the more marked and great enlargements, 75 per cent of them occurred among females.

(4) The age groups most affected were 10 to 14 for males and 15 to 19 for females.

(5) Less than one-tenth of 1 per cent showed definite signs of toxicity and nearly all of these were females, while another one-tenth of 1 per cent were classed as possibly having some underlying toxic condition. Another group, about equal in number to these two combined, complained of pressure symptoms.

(6) No race was found free from thyroid enlargement. Indians were slightly less susceptible than whites, but enlargement seems to occur more frequently among the male than the female Indians. The reverse is true among whites.

(7) Pupils in the Roman Catholic parochial schools were found to have fewer enlargements than the pupils in the State schools.

(8) No part of the State of Utah is goiter free; generally there is more thyroid enlargement in the southern than in the porthern part. Wide differences often exist between near-by places.

(9) Those localities using well water have much fewer enlargements than those using mountain (snow) water.

(10) Urban districts generally had a higher incidence than rural, because a greater proportion of the latter use well water.

(11) Isolated rural districts using mountain water had the highest incidence of all.

(12) There seems to be a direct correlation between the incidence of thyroid enlargement and the quantity of iodine in the local water supply. They are in inverse ratio.

(13) Great variations are found both in iodine content of the water, and in the incidence of thyroid enlargement in different localities throughout the State.

(14) Examination of adults in intensive goitrous areas shows that the percentage of enlargements in children that spontaneously clear up without treatment is very small—perhaps less than 20 per cent for males and 10 per cent for females.

(15) The percentage of cases in adults that cause trouble in one form or another is considerable, at least 10 per cent among females of all ages and over 35 per cent among females over 40 years of age.

**(16) Iodine prophylaxis, so far as has been observed, has been beneficial to the school population, and has proved to be curative in many cases where an enlargement already existed.**

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## THERAPEUTIC USES OF CARBON DIOXIDE

"The therapeutic uses of carbon dioxide" is the title of a paper by James C. White, M. D., and Lewis M. Hurxthal, M. D., of the Massachusetts General Hospital, which was published in the December 15, 1927, number of the Boston Medical and Surgical Journal.

The authors show that since 1920, the year in which Henderson and Haggard first used carbon dioxide as a respiratory stimulant, the gas has been used for treatment in many conditions.

Although it is not definitely settled that carbon dioxide is a respiratory stimulant, it is known that a rise in its tension in the blood is accompanied by an increase in the rate and depth of respiration.

White and Hurxthal state that they have never observed any deleterious effect from inhaling moderate concentrations of carbon dioxide in suitable cases. There is a sensation of fullness in the head, and a slight rise in pulse rate and blood pressure accompanies its inhalation.

The gas is used mixed with air, the only time the authors have found it advisable to use it in combination with oxygen being in cases of poisoning with carbon monoxide.

The conditions mentioned in which the gas has been used as a respiratory stimulant are:

1. *Resuscitation from carbon monoxide or illuminating gas poisoning.*—In this condition, the combination of the carbon monoxide with the hemaglobin results in an anoxemia. This causes, at first, a period of overventilation, with a loss of carbon dioxide and a lowering of its tension in the alveoli and blood. Following this, there is a depression. If treatment is not quickly given, cerebral edema develops, as a result of the anoxemia of the brain, and the respiratory depression may continue after the blood has returned to normal. The victim, if he survives the acute poisoning, is very liable to develop pneumonia. Therefore, it is important to give carbon dioxide and oxygen, in order that pulmonary ventilation may be increased by the former and the partial pressure of the latter raised.

Artificial respiration should be started if the patient is not breathing. Then a mixture of 95 per cent oxygen and 5 per cent carbon dioxide should be given, the inhalation to be kept up until recovery is established, usually a matter of 30 to 40 minutes.

This method of treatment holds out more hope than any other yet devised in cases of carbon monoxide poisoning.

2. *Deetherization of patients after operation.*—Carbor dioxide increases greatly the elimination of ether during the early stage of recovery, but, since with returning consciousness the patient always becomes noncooperative, the final stages of recovery are not shortened. The authors have given up the routine use of $CO_2$ for this purpose.

3. *Induction of anesthesia and other uses during operation.*—Modern apparatus for giving anesthetics by the closed method is so devised that carbon dioxide may be given in combination with the anesthetic—ethylene, nitrous oxide, or ether. This allows the anesthetist to control the breathing of the patient at will. Giving carbon dioxide at the end of the operation shortens the period of recovery, as stated above.

4. *Resuscitation from alcoholic intoxication.*—Patients in an alcoholic coma, with feeble, thready pulse and respiratory depression, have been brought to complete consciousness in 30 minutes and have become completely rational in from 15 to 30 minutes more, by inhalation of carbon dioxide. All had less " hang-over " than was expected. Mildly intoxicated patients do not receive the same benefit.

5. *Combating respiratory failure after overdoses of depressant drugs.*—In morphine poisoning, where the patient is too sick to be made to walk about, adequate respiration may be obtained by inhalations of carbon dioxide. One of the writers treated successfully by this method a patient poisoned by veronal. Its use in any case of poisoning where the respiration is greatly depressed seems indicated.

6. *Treatment of hiccoughs.*—Since the report made in February, 1927, by Sheldon, of the Massachusetts General Hospital, of four severe cases of hiccoughs which were relieved by inhalations of carbon dioxide, this method of treatment has been used, in the same hospital, on a large number of cases. Relief, sometimes only transitory, has followed in every case.

7. *Resuscitation of the new born.*—The authors have had no personal experience with this, but quote from Lundy's paper to show that carbon dioxide and oxygen inhalations have been successful in establishing respiration in newborn infants who did not breathe well. Five per cent of carbon dioxide is given through a closed mask at a positive pressure of 3 centimeters of water.

8. *Stimulation of respiration in cases of trauma to the respiratory center.*—One of the authors (White) has, in an earlier paper, reported four cases, three following operation for tumor of the brain and one following decompression, in which the patients seemed moribund from respiratory depression. All responded to treatment with carbon dioxide and regained consciousness. One died later. Cheyne-Stokes respiration has been changed to normal breathing by inhalations of carbon dioxide, and several patients have eventually recovered.

9. *Expansion of atelectatic lung by carbon dioxide.*—The patient with a collapsed lung after thoracotomy for empyema may be taught to give himself periods of strong respiration by using carbon dioxide (5 per cent) from a simple inhaler, with great benefit. The authors state that this, in their opinion, is harmless and not disagreeable to the patient. However, this method should only be supplemental to the usual breathing exercises prescribed.

The authors conclude their paper with a brief reference to the non-respiratory uses of carbon dioxide, but, as such use is unimportant, this part of their paper will not be abstracted.

The authors' summary is quoted in full:

(1) Any increase in the carbon dioxide of inspired air up to 10 per cent will cause a corresponding increase in the pulmonary ventilation. We have used concentrations varying from 5 per cent to 7 per cent, as greater amounts cause labored respiration and strain on the circulatory system.

(2) We recommend its addition to the inspired atmospheric air for all purposes where a respiratory stimulant is desired.

(3) Only in resuscitation from carbon monoxide poisoning is it necessary to give it in oxygen rather than in atmospheric air.

(4) It is now proven of therapeutic value in the rapid elimination of volatile drugs, in stopping prolonged attacks of hiccoughing, in resuscitation of the new born, and as an aid to the expansion of collapsed tissue.

(5) There are practically no contraindications to its use in quantities necessary to produce moderate degrees of hyperpnea.

(6) It should be emphasized that its use is only to supplement, and not in any way to displace, other therapeutic procedures.

## VOLATILE OILS AND FUNGI

In the Journal of the American Medical Association (November 26, 1927), Harold B. Myers, M. D., reports the results of some experiments conducted to determine the fungicidal properties of thymol and other volatile oils. While treating some cases of infections, chiefly of the hands, in workers in fruit canneries, which did not respond to the use of the ordinary antiseptics, he recalled that cinnamon water is used to prevent mold growth in certain medicinal preparations and tried it on his patients with excellent results. This led him to carry out the laboratory experiments which he reports.

The summary of the report and the conclusions reached by Myers follow:

Cultural results with a yeast producing typical lesions in fruit handlers indicate marked fungicidal activity by thymol, its isomer carvacrol, and the volatile oils of mustard, cinnamon, and clove. Thymol and the oils of cinnamon and clove proved equally fungicidal toward other yeasts of apparent pathogenicity. Thymol, but not the oils, proved equally destructive to *Actinomyces hominis*. * * * Toleration or fastness is apparently not developed by yeast toward these oils. A few observations of therapeutic use support the cultural results.

### Conclusions

1. Thymol, carvacrol, and the volatile oils of mustard, cinnamon, and clove possess marked fungicidal powers.
2. The remainder of a large group of the more commonly used volatile oils are comparatively inactive toward the yeasts.
3. Therapeutic trial of thymol and the oils of cinnamon and clove in treating mycotic infection seems warranted.

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## LEPTOSPIRA ICTEROIDES

Serious doubt has been cast by several investigations upon the authenticity of the *Leptospira icteroides* as the causative agent in yellow fever.

Among those who have attempted to settle the matter are Andrew W. Sellards and Max Theiler, of the department of tropical medicine, Harvard Medical School, who conducted experiments with the Pfeiffer reaction and protective tests in Weil's disease with *Leptospira icterohaemorrhagiae* and *Leptospira icteroides*, and reported their results in the American Journal of Tropical Medicine for November, 1927.

As a result of their experiments they have reached the conclusion that:

1. The serum of 5 patients and 1 guinea pig after recovery from leptospiral jaundice (Weil's disease) gave positive Pfeiffer reactions and protected guinea pigs against *L. icterohaemorrhagiae* and *L. icteroides*.
2. A series of titrations showed that these 6 immune sera were essentially equal in their effects against these 2 strains of leptospira.
3. From an etiological standpoint *L. icteroides* is a synonym of *L. icterohaemorrhagiae*.
4. If the serum of a patient convalescent from an attack of acute infectious jaundice gives positive Pfeiffer reactions with protection of guinea pigs against either *L. icterohaemorrhagiae* or *L. icteroides*, the diagnosis of leptospiral jaundice (Weil's disease) is justified. Negative reactions are consistent with the diagnosis of yellow fever.

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## BENZOL POISONING

Case records of the Massachusetts General Hospital, as edited by Dr. R. C. Cabot, and published in the Boston Medical and Surgical Journal, always contain much of value and are splendid illustrations of the correct methods of arriving at a diagnosis in unusual or obscure cases.

In the September 29, 1927, number of this periodical, the case is reported of a girl of 20, unmarried, a worker in a rubber-shoe factory, who entered the hospital April 7, complaining of "profuse bleeding from the nose for two days."

This girl had been working in the factory for eight months and for four months had felt very tired and had been nauseated by the smell of the cementing substances used. She had been getting weaker recently, and two months before admission had a severe nosebleed which was easily stopped. Menstruation, a month before admission, was unusually profuse and lasted three days longer than usual. Two weeks before admission her gums became sore and swollen, and bled easily. Also, she felt dizzy, especially on bending over. On April 6, on blowing her nose, she had a severe hemorrhage from both nostrils, which was stopped after seven hours by pledgets. The bleeding recurred when these were removed the next morning.

The family history and the past history of the patient were essentially negative.

The work of the patient was cementing rubber heels. It was not unusual for girls working at this to feel ill and ask to go home.

Upon admission to the hospital the patient was very pale, breath was repulsive, there were hemorrhagic edges to several of the teeth, there was a diffuse brown pigmentation of the skin, and there were many large purpuric spots on the lower extremities. Heart was slightly enlarged. Blood pressure was 110/70 to 100/82.

The urine was turbid and cloudy at four examinations and contained gross blood at a fifth. The blood count was as follows: Red blood cells, 1,715,000; hemoglobin, 40 per cent; white blood cells, 1,200; polynuclears, 16 per cent; lymphocytes, 76 per cent; large mononuclears, 8 per cent. Platelets were practically absent. There were no reticulated cells. Bleeding time was 16 minutes and clotting time, 12 to 19 minutes. Wassermann and Widal tests were negative. The stools contained blood on two examinations.

Temperature, 100.3° to 105.8°; pulse, 100 to 162; respirations, 20 to 48.

Several transfusions were done and quartz lamp treatment was given. There was a steady rise in the red count and hemoglobin and an irregular fall in the leucocyte count to 400 on April 22. Platelets and reticulocytes were markedly reduced in all smears.

April 24 there was a large hemorrhage from the vagina and lungs, and the patient died April 26.

Doctor Cabot, in the discussion of the case, considered the most prominent symptoms to be the nosebleeds and trouble with the gums.

The blood, he considered the interesting thing in the examination. The absence of reticulated cells implied that there was no attempt at regeneration in the marrow and the leucocyte count was the lowest he had seen.

The treatment was ineffective.

In considering the differential diagnosis, Doctor Cabot stated that she certainly died of anemia and that it seemed natural to consider it an aplastic anemia. The infection around the mouth, however, caused him to think of a secondary septic anemia. The high relative lymphocytosis suggested leukemia, but there were no other grounds to support this. The continuous fever might have occurred in any of the anemias. He saw no conclusive evidence of industrial poisoning, although she worked in a rubber-shoe factory, and he thought of lead and benzol as possible causes.

Another doctor stated that there had been seven almost exactly similar cases from the factory in which this girl worked, which, of course, pointed strongly to industrial poisoning. Lead was probably not at fault, as it does not cause a decrease in white cells. Benzol does. The bleeding was characteristic of aplastic anemia, but Doctor Cabot did not remember having heard of it in connection with benzol poisoning. He said, however, that if benzol hit the white cells it would also hit the platelets and cause hemorrhage. All things considered, he was inclined to the diagnosis of benzol poisoning rather than aplastic anemia.

Later it was learned that the cement used contained 80 per cent of benzol. A consultant stated that the blood smear was typical of benzol poisoning.

Doctor Cabot's diagnosis of benzol poisoning was corroborated at autopsy; that is, changes consistent with this diagnosis were found. The pathologist, Doctor Mallory, said, however, "* * * I do not believe there is any pathological difference that would justify one in making an absolute diagnosis of benzol poisoning. All that we can say is that it is consistent with it, and when we have a history like this there is no doubt about it."

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## ETHYLENE-OXYGEN ANESTHESIA

Current Researches in Anesthesia and Analgesia, for December, 1927, contains an article by Isabella C. Herb, M. D., Glencoe, Ill., entitled "Further clinical experiences with ethylene-oxygen anesthesia."

Since 1923, when this method of inducing surgical anesthesia was introduced, Doctor Herb has used ethylene-oxygen mixture in many thousands of cases and remains very enthusiastic concerning its advantages.

The entire article is worth reading, but only the conclusions reached will be given here. They are as follows:

Ethylene is superior to nitrous oxide in that it produces better relaxation and because sufficient oxygen can be given with it to prevent cyanosis, hence

there is better oxygenation of tissues throughout anesthesia. It does not, however, produce as great relaxation as ether. There is little or no sweating during anesthesia, which is of value in the weak or dehydrated patients, as heat and fluid are thus conserved. Postoperative condition of the patient is better than following ether anesthesia, because there is little or no vomiting. It does not irritate the respiratory tract, consequently ethylene can be given during acute or chronic pulmonary infections without fear of aggravating the inflammatory process. It does not depress respiration or circulation, hence is eminently the anesthetic of choice for the handicapped patient when a general anesthetic is indicated. It does not depress kidney function, hence it is preferable to ether in ureteral catheterization and preferable to nitrous oxid in severe bladder disease because the bladder reflex is not so active.

It is explosive and should not be given in the presence of an open flame, actual cautery, or any sort of an electrical apparatus capable of producing a spark. Explosions due to static conditions can be controlled by proper grounding.

## REPORT OF SURGEON GENERAL, UNITED STATES PUBLIC HEALTH SERVICE, 1927

The Annual Report of the Surgeon General, United States Public Health Service, for 1927, shows that health conditions throughout the world were better than in any previous year on record. But for the epidemic of influenza which swept all of Europe, the mortality rates on that continent would have been considerably lower than they were.

In the United States the death rate for all causes for the calendar year 1926 in 28 States was 12.1 per 1,000 population. The slight increase over the rate for the year 1925—11.7 per 1,000—was principally due to deaths from respiratory diseases.

The death rate from tuberculosis continued its decline, and the rates for heart disease, diabetes, and nephritis were lower than was expected.

Yellow fever, with the exception of one case which occurred at Bahia, Brazil, in July, 1926, was not reported in the Western Hemisphere.

Thanks to the vigilance of the Public Health Service, no cases of yellow fever, cholera, or bubonic plague gained entrance to the United States during the year. Bubonic plague, was found three times among rats in Los Angeles, which shows the necessity for constant watchfulness.

During the year tularaemia was discovered in 10 additional States. The area in which this disease is now known to exist includes 36 States, the District of Columbia, and Japan.

Rocky Mountain spotted fever was reported last year from 9 States.

The work of the Public Health Service in preventing the introduction of diseases from abroad involves both control at domestic ports

and medical inspections at certain foreign ports. At domestic ports during the year, 20,284 vessels, 820,793 passengers, and 1,140,922 seamen were inspected by quarantine officers; at insular ports, 2,991 vessels, 169,461 passengers, and 226,373 seamen were inspected; and at foreign ports, 5,954 vessels, 424,172 passengers, and 272,873 seamen were inspected prior to embarking for the United States. A total of 7,116 vessels were fumigated. Rats recovered numbered 31,073, of which 18,334 were examined for plague infection.

The Public Health Service was organized under the act of July 16, 1798—129 years ago—to provide medical and hospital treatment for sick and injured American merchant seamen. This one of its functions is still being carried on, as is shown by the fact that more than 300,000 beneficiaries apply annually at 152 ports of the United States and its insular possessions, where marine hospitals and relief stations are maintained. Over a period of many years about 20 per cent of all patients treated were ill as the result of venereal diseases. In 1926 the rate was 17.

The service has been active in its antimalarial campaigns and has amply demonstrated the efficacy of airplane control of mosquitos by spreading larvicidal dust.

Among the other diseases which have been investigated during the year by the Public Health Service may be mentioned pellagra, tularaemia, tuberculosis, Malta fever, typhus fever, trachoma, pneumonia, encephalitis lethargica, Rocky Mountain spotted fever, syphilis, goiter, influenza, and leprosy.

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## THE BUDAPEST CONGRESS, SEPTEMBER, 1928

The Fifth International Medical Congress for Industrial Accidents and Occupational Diseases" is to be held in Budapest during September, 1928. The executive committee consists of the following: President, Dr. Tibor de Verebély, professor at the university; vice president, Dr. William de Friedrich, professor at the university; secretary general, Privatdozent Dr. George Gortvay, section chief.

The national committee for the United States has been created and consists of the following: Dr. Volney S. Cheney, Chicago; Dr. R. W. Corwin, Pueblo; Dr. Eugene L. Fisk, New York; Dr. Otto P. Geier, Cincinnati; Dr. Leonard Greenburg, New Haven; Dr. George M. Kober, Washington, D. C.; Dr. W. J. McConnell, Philadelphia; Dr. Lloyd Noland, Birmingham; Dr. Francis D. Patterson, Philadelphia; Dr. George M. Price, New York; Dr. Frank L. Rector, Chicago; Dr. William A. Sawyer, Rochester; Dr. Henry F. Smyth, Philadelphia; Dr. C.—E. A. Winslow, New Haven; and Dr. Emery R. Hayhurst, Columbus, chairman.

Addresses already scheduled by various prominent Europeans include the following: Prof. J. Liniger, Frankfort on the Main; Dr. F. Zollinger, Aarau; Prof. K. B. Lehmann, Wurzburg; Sir Thomas Oliver, London; Prof. J. G. Sleeswijk, Delft; Prof. Jütten, Munster; Professor Koelsch, Munchen; Prof. Julius van der Hoeve, Leiden; Prof. Dr. Stephan Jellinek, Vienna. Also lectures are scheduled to date by the following: Prof. Salvatore Diez, Rome; Dr. C. Poenaru Caplescu and Doctor Presbeanu, Bucharest; Prof. Theodor Sommerfeld, Berlin; Dr. Lorenz Böhler, Vienna; Professor Doctor Quensel, Leipzig; Prof. Dr. C. Marcus, Breslau; Professor Doctor Molineus, Dusseldorf; and Sanitätsrat Dr. Alfred Peyser, Belin-Charlottenburg.

Addresses and lectures are wanted from American physicians, dentists, and other specialists in the field. Such are requested to get in touch with the chairman for the national committee for the United States, Dr. Emery R. Hayhurst, Hamilton Hall, Ohio State University, Columbus, Ohio. General invitation is also extended to attend the congress, which will be arranged so as to coordinate with the "Deutscher Naturforscher Tag" to be held in Hamburg and the "Orthopädenkongress" to be held at Prague during the month of September, 1928.

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## THE ASSOCIATION OF MILITARY SURGEONS

During the past few years membership in the Association of Military Surgeons of the United States has been growing at a rapid rate among all classes of those who are eligible, with one exception. The exception, unfortunately, is that class composed of naval medical officers. Navy membership in the association has decreased. Some of this decrease has been due to resignations, but even more of it has been due to members being dropped for failure to pay their dues. This, of course, should not be, and it is not believed that any naval medical officer would intentionally allow himself to become so far in arrears as to justify his being dropped from the rolls of any organization to which he belongs. The fact remains, however, that Navy members are being dropped for this reason. It seems probable that the failure to pay is due to one of two things—carelessness or lack of interest. If it be the first, simply calling attention to the fact that a member is delinquent will be sufficient. If it be lack of interest, a better understanding of the organization and its aims will correct this.

The membership of the Association of Military Surgeons of the United States is made up of those who are now, or have been, commissioned officers in the Medical Department of the Army, the Navy, the Public Health Service, the National Guard, and the Reserve. In

addition, members of the medical service of the United States Veterans' Bureau, members of the Air Service Medical Association, and members of the Medical Veterans of the World War have recently become eligible for membership. In other words, its membership is composed of men whose chief aim is to promote the efficiency of military medicine—and this includes naval medicine.

That the efficiency of the medico-military service of the United States may best be increased by members of all its components coming together for conference and study of interlocking problems is a truism.

The Association of Military Surgeons of the United States is the only organization in our country which affords an opportunity for this getting together, and for this reason, if for no other, should be liberally supported by naval medical officers. In fact, naval medical officers who wish to get the most out of their service, and to give their best to their service, must, of necessity, belong to it and make use of the advantages that arise from such membership.

It is frequently stated that little of interest to medical officers of the Navy is published in The Military Surgeon, the official publication of the organization. It is true that little which applies only to the Navy appears in its pages. But it is also true that much which applies to land warfare, to camp sanitation, to medico-military history, and to organization of troops applies equally to the problems of naval medicine, and a knowledge of these must be of value to the naval medical officer.

The cost of membership in the association—$3 a year—is too small to be considered, when the value of membership is understood.

Another feature of membership which alone is worth far more than the cost is the opportunity that is presented at the annual meetings for medical officers of all branches of the military services of the United States to mingle in fellowship. Much good is accomplished by the informal gatherings that form such a prominent part of these meetings, and medical officers return from them with a new and better understanding of the problems of their sister services and in a better position to cooperate with them should the occasion arise.

It is hoped that those naval medical officers who have been dropped from the rolls of the association for nonpayment of dues will reinstate themselves by paying their back dues as soon as possible; that those members of the association who have seemingly lost interest in it may, through increased activity in furthering its aims stimulate anew their own interest; and that the younger medical officers who have never given much thought to the subject may see that by joining the association they will increase their own chances to obtain a knowledge of medico-military matters and thereby make themselves more valuable members of the service to which they belong.

## BULLETIN INTERNATIONAL

The first number of the Bulletin International, the official organ of the International Congress of Military Medicine and Pharmacy, has been issued and copies have been received by the bureau.

The cost of subscription to this bulletin is 8 belgas per annum. Medical officers of the Navy are invited to subscribe.

According to the first number, the bulletin will be published in French and English until its financial condition becomes such as to justify its publication in other languages.

The bulletin will be truly international in its scope and will be of interest to all medical officers of any branch of the service.

Subscriptions should be sent to Major médecin Voncken, Secrétaire du Comité Permanent, Comité International de Médecine et de Pharmacie Militaires, Hôpital Militaire de Liége, Belgique.

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## SPECIAL ANNOUNCEMENT

The Thirteenth Annual Convention of the Catholic Hospital Association of the United States and Canada and the Second Annual Hospital Clinical Congress of North America will be held in the Cincinnati Music Hall, Cincinnati, Ohio, June 18 to 22, inclusive, 1928. The Fourth Annual Convention of the International Guild of Nurses will be held at the same time, in the same building, at night meetings.

This convention and congress will be one of the largest and most important hospital meetings of the year, and will comprise general scientific meetings, special clinics or demonstrations of hospital departments, and 300 special commercial and educational exhibits. Outstanding authorities in medicine, surgery, pathology, nursing, dietetics and hospital administration, architecture, and engineering will lecture and demonstrate in specially planned clinics representing the various departments of the modern hospital. A professional program of the highest interest and value is now being formulated, and all persons interested in medical and hospital service are cordially invited to attend. Further information may be obtained from John R. Hughes, M. D., dean of the College of Hospital Administration, Marquette University, Milwaukee, Wis., who is general chairman of the convention and congress.

# BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.
(For review.)

HANDBOOK FOR THE MEDICAL SOLDIER, by *Arnold Dwight Tuttle, Major, Medical Corps, United States Army.* William Wood & Co., New York, 1927

This work is particularly well adapted to the purpose for which it was prepared—to present to the enlisted personnel of the Medical Corps of the Army the basic knowledge of medico-military matters.

Major Tuttle is to be commended upon the convenient size of the book, the style, and the interesting manner in which the various subjects are presented. The illustrations and cuts, which have been well chosen, are a valuable asset, and the index has been carefully prepared. Chapters 1 to 10, inclusive, present in a very interesting manner the military part of the knowledge a medical soldier should possess. Chapters 11 to 18, inclusive, embrace the medical part, while chapters 19 to 24 take up the clerical work, administration, and miscellaneous subjects which pertain to the medical soldier and his relation to the other branches of the military organization.

The chapters on "First aid," "Administration," and "Hygiene and sanitation" are most interesting, instructive, and particularly well presented. The chapter on "Defense against chemical warfare" is an especially valuable one.

PRACTICAL THERAPEUTICS, by *Hobart Amory Hare, B. Sc., M. D., LL. D., Professor of Therapeutics, Materia Medica, and Diagnosis in the Jefferson Medical College of Philadelphia, etc.* Twentieth edition. Lea & Febiger, Philadelphia, 1927

The twentieth edition of Professor Hare's work has now been published, and, as is the custom of this author, he has included the latest developments of therapy in this edition. Years ago we were referred to his book for its simplicity and convenience, and in study-

ing many editions since then we find each one a step forward in presenting the subject of therapeutics in a readily available manner. Not only do we find a discussion of the recent changes in ideas concerning the use of the arsenic compounds, but also much excellent material has been included in other lines, notably on some of the newer drugs and dietetic treatments. We congratulate the writer on the completeness of his book and its great value as an easy source of information to the practitioner in his bedside work.

SURGERY, ITS PRINCIPLES AND PRACTICE, by *Astley Paston Cooper Ashhurst, A. B., M. D., F. A. C. S., Professor of Clinical Surgery in the University of Pennsylvania.* Third edition. Lea & Febiger, Philadelphia, 1927

This book is planned to be "a source of information which shall indicate where further knowledge is to be obtained." Further, it attempts to lay the foundations of surgery broad and deep in order that a useful superstructure may be built thereon. The task has been well done.

While primarily designed for the use of medical students, the book is a useful reference work.

That great source of vagueness and ambiguity, the assumption that the reader already knows what is alluded to, has been unusually well avoided by the use of judicious and adequate cross references. Thus repetition is avoided while details are given in full.

The name of each investigator or originator of a procedure is given in each instance, together with the date. This is designed to facilitate reference to Index Medicus and Index Catalogue of Surgeon General's Library, United States Army.

Perhaps the most valuable feature of the book is the study of individual cases and the use of such cases, after years of observation of end results, to illustrate basic principles of treatment.

EXPOSURES OF LONG BONES AND OTHER SURGICAL METHODS, by *Arnold K. Henry, M. B., B. Ch. (Univ. Dublin), F. R. C. S. L., Chevalier, Legion d'Honneur; Professor of Clinical Surgery, Royal School of Medicine, Cairo; Director of the Surgical Unit, Kasr et Aini Hospital.* Foreword by *Sir W. I. deC. Wheeler (Dublin).* William Wood & Co., New York, 1927.

A republication of several papers written between 1920 and 1926. Besides the one on the long bones, they are: "Exposure of the plantar structures"; "A method of ligating the second stage of the vertebral artery"; "A method of ligating the first stage of the left subclavian artery from behind"; "A cup-and-ball aneurysm needle for deep ligations"; "A new method of resecting the left cervico-dorsal ganglion of the deep sympathetic"; "Pituitary surgery by a new method."

The section on exposure of the long bones is valuable. Until the appearance of the tenth edition of Scudder's book, there was no readily available and reliable guide to the best route. Professor Henry's little book gives it in brief and accurate form which will be appreciated by the surgeon. Each of the other papers gives the solution of a problem presented by some patient's lesion.

RADIUM IN GYNECOLOGY, by *John G. Clark, M. D., former Professor of Gynecology, University of Pennsylvania; Gynecologist in Chief to the University Hospital,* and *Charles C. Norris, M. D., Professor of Gynecology and Obstetrics, University of Pennsylvania, Gynecologist to the Radiologic Staff of the Philadelphia General Hospital.* With a chapter on physics by *Gioacchino Failla, E. E., M. A., D. Sc., Physicist, Memorial Hospital, New York.* J. B. Lippincott Co., Philadelphia, 1927.

This is a report of the results obtained by the use of radium in gynecology for several years by these distinguished men. Their conclusions are important and authoritative for those engaged in this specialty. But the chief interest of the book to most of us in the Navy lies in another feature.

About two-fifths of the book are devoted to a history of the discovery of radium and its physics. In the historical section it is pleasing to note that proper credit is given to Henri Becquerel for the discovery of radio-active substances, the foundation of Mme. Curie's work in radium.

The author of the chapter on the "Physics of radium" is Gioacchino Failla, a great authority on this subject who has worked out numerous problems in the procuring, handling, and application of radium. He designed and installed the radium vaults and radium-emanation apparatus of the Memorial Hospital, New York, and other large clinics. His section of the book is a clear and interesting story of the wonders of radium and its degeneration products.

The high cost of radium is easily understood when the details of its production are known. From 2,000 to 2,500 tons of rock and other materials must be handled in the mines of the Belgian Congo to secure the 500 tons of carnotite from which 1 gram of radium is obtained. The 500 tons of ore are shipped to Belgium for reduction, in which process an equal weight of chemicals and 10,000 tons of distilled water are needed. In addition, 1,000 tons of coal are consumed for heat and power required in the process, which occupies a time of more than six months.

For the gynecologist, this book is a reliable guide to the use of radium in his specialty. For others, it provides a clear and readable account of the history and physics of radium.

PYELOGRAPHY, by *Alex. E. Roche, M. A., M. D., M. Ch. (Camb.), F. R. C. S. (Eng.) Chief Assistant to a Surgical Unit, St. Bartholomew's Hospital; late Clinical Assistant, House Surgeon, and Resident Surgical Officer, St. Peter's Hospital for Stone and Other Urinary Diseases; late Classical Scholar, Magdalene College, Cambridge.* With an introduction by *Sir John Thomson-Walker, O. B. E., M. B., C. M., F. R. C. S., Senior Urologist and Lecturer on Urology, Kings College Hospital; Surgeon to St. Peter's Hospital for Stone and Other Urinary Diseases.* William Wood & Co., New York, 1927.

This monograph covers the field indicated by its title in a clear and thorough manner. It is based on 58 personally observed pyelographies, 36 of which were performed by the author. One gathers that the use of this method is not so general in England as it is in this country.

DISEASES OF THE NOSE, THROAT, AND EAR, Edited by *A. Logan Turner, M. D., LL. D., F. R. C. S. (Eng.), Consulting Surgeon, Ear and Throat Department, Royal Infirmary, Edinburgh; formerly Lecturer on Diseases of the Ear, Nose, and Throat, University of Edinburgh;* with the collaboration of *J. S. Fraser, M. B., F. R. C. S. E.; J. D. Lith Gow, M. B., F. R. C. S. E.;* W. *T. Gardiner, M. C., M. B., F. R. C. S. E.; G. Ewart Martin, M. B., F. R. C. S. E.;* and *Douglas Guthrie, M. D., F. R. C. S. E.* William Wood & Co., New York 1927.

This interesting work will serve as a text for the student or as a reference for the otolaryngologist.

The authors have covered their subjects thoroughly.

The sections on otosclerosis, intracranial complications, the labyrinth, and the eighth nerve have been rewritten. This portion, especially, is up to date in every respect. The specialist will find this edition a useful addition to his library.

HANDBOOK OF DISEASES OF THE EAR, by *Richard Lake, F. R. C. S. (Eng.), Consulting Surgeon, Royal Ear Hospital (University College Hospital); Duveen Lecturer in Otology, University of London,* and *E. A. Peters, M. D. (Cantab.) F. R. C. S. (Eng.), Surgeon, Royal Ear Hospital; Surgeon, Nose, Throat, and Ear department, Bolingbroke Hospital.* Wm. Wood & Co., New York, 1927.

The authors have contributed a book that contains a great deal of useful information in condensed form. One is immediately impressed with the clearness in presentation of the subject matter.

That portion relating to the vestibular apparatus is especially noteworthy.

OPHTHALMOSCOPY, RETINOSCOPY AND REFRACTION, by *W. A. Fisher, M. D. F. A. C. S., Professor of Opthalomolgy, Chicago Eye, Ear, Nose, and Throat College.* F. A. Davis Co., Philadelphia, 1927.

This book will be of value not only to the student in ophthalmology, but to the internist. Too many medical men are unable to use the ophthalmoscope and are therefore unable to complete physical examinations without referring the patient to a specialist.

The author presents his subject in a very practical manner and we recommend this book to the man practicing general medicine.

AN INTRODUCTORY COURSE IN OPHTHALMIC OPTICS, by *Alfred Cowan, M. D., Assistant Professor of Opthalomolgy in the Graduate School of Medicine, University of Pennsylvania.* F. A. Davis Co., Philadelphia, 1927.

This text is an excellent one for the student. The author presents the subject in a quite thorough manner and even though the student may have but an elementary knowledge of mathematics, he will be able to arrive at a correct understanding of the various subjects. The chapters dealing with the dioptric system, myopia, hyperopia, astigmatism, and accommodation are especially commended.

THE OPHTHALMIC YEAR BOOK, Volume XXIII, edited by *Wm. H. Crisp.* The Ophthalmic Publishing Co., Chicago, 1927

The yearbook, as usual, gives a very complete digest of current ophthalmic literature of the year. The bibliography is of the greatest value.

It will be a great loss to the ophthalmologists of this country if the yearbook is discontinued, as now seems probable.

PRACTICE OF UROLOGY AND SYPHILOLOGY, by *Charles H. Chetwood, M. D., LL. D., F. A. C. S., Attending Urologist and Director of Service, French Hospital; Consulting Surgeon to Bellevue Hospital; Member American Association of Genito-Urinary Surgeons, American Urological Association; L'Association Internationale D'Urologie.* Fourth edition. William Wood & Co., New York, 1927.

A very excellent treatise, which covers the whole field as completely as can be done in a single volume. Endoscopy and instrumental methods of diagnosis, endothermy, caudal block, and spinal anesthesia and other modern developments are well described.

It is admirably adapted for the use of the general practitioner or one who is in the early stages of specialization in this branch.

TEXTBOOK ON DISEASES OF THE SKIN AND SYPHILIS, by *Albert Strickler, M. D., Professor of Dermatology and Syphilology, Temple University Department of Medicine; Dermatologist to the Samaritan Hospital; former Associate in Dermatology and Syphilology, Jefferson Medical College; former Assistant Dermatologist, Jefferson Hospital, etc.* F. A. Davis Co., Philadelphia, 1927.

A textbook designed for teaching purposes and adapted to the needs of the general practitioner.

The reviewer does not feel competent to pass upon the general merits of a book on skin diseases, but if the other sections of the book are of the same quality as the chapter on cancer of the skin, which he does feel competent to judge, the author has done well. This section, in which attention is first directed to the precancerous lesions, describes the types of skin cancer and their peculiarities of location

and growth, also the modern methods of treatment, and ends with a very fair estimate of their relative worth.

DEMONSTRATIONS OF PHYSICAL SIGNS IN CLINICAL SURGERY, by *Hamilton Baily, F. R. C. S. (Eng.), Surgeon Dudley Road Hospital, Birmingham; late Honorary Assistant Surgeon, Surgical Registrar, and Tutor, Liverpool Royal Infirmary; Surgical Registrar and First Surgical Assistant, London Hospital, etc.* William Wood & Co., New York, 1927.

This book represents an effort in opposition to the growing tendency to rely on laboratory and other auxiliary reports for a diagnosis. The author contends that the history and physical methods of examination must always remain the main channels by which a diagnosis is reached.

He develops his thought in a logical way, devoting a chapter to each region of the body. Elicitation of physical signs and the method of reasoning therefrom are emphasized.

One wishes that the author's idea could be implanted in the mind and his book placed in the hand of every young medical officer. If anyone should doubt the need for this, let him try to get any physician of recent vintage to reach a diagnosis in a case of syphilis, tuberculosis, or peptic ulcer before calling on the laboratory for help.

A MANUAL OF CHEMISTRY, by *W. Simon, Ph. D., M. D., late Professor of Chemistry in the College of Physicians and Surgeons of Baltimore, and in the Baltimore College of Dental Surgery, and Daniel Base, Ph. D., late Professor of Chemistry in the Maryland College of Pharmacy, Department of the University of Maryland, Baltimore.* Thirteenth edition, enlarged and thoroughly revised by *John C. Krantz, jr., Phar. B., Sc. D., Professor of Pharmacy in the University of Maryland.* Lea & Febiger, Philadelphia, 1927.

The subject matter is presented in four parts. Section I is devoted to fundamental properties of matter and heat, Section II to general chemistry, Section III to analytical chemistry, and Section IV to organic chemistry. Special attention is given to those subjects of especial interest to medical men. In scope this manual is more comprehensive than is ordinarily the case with a book intended for students of medicine.

The appendix contains a brief exposition of the spectroscope and polariscope. The volume will prove to be a handy reference.

APPLIED ORTHODONTIA, by *James David McCoy, M. S., D. D. S., F. A. C. D., Professor of Orthodontia, College of Dentistry, University of Southern California, Los Angeles.* Second edition, thoroughly revised. Lea & Febiger, Philadelphia, 1927.

This book, although of modest size, covers the subject with sufficient thoroughness to make it valuable in the library of every general dental practitioner who is interested in orthodontia. In addition to covering treatment of various types of oral and facial deformities

and post-treatment care, the author outlines the object and scope of orthodontia and the etiology of malocclusion interestingly. Among the high lights is the endeavor to dispel certain old-fashioned notions concerning the importance of heredity in the causation of deformities, the use of materials, and the age at which treatment should be instituted. Orthodontia is presented as a biological problem, and various phases of this side of the specialty are discussed in connection with growth and development. The book is well printed, and the illustrations are particularly well arranged in relation to the text.

CONVALESCENCE, by *John Bryant, M. D.* The Burke Foundation, New York, 1927.

Convalescence, a most important and greatly neglected part of all medical treatment, is ably discussed by the author, from historical and practical viewpoints, in this volume, the first of its kind to be published.

The author holds that in order for any community to consider itself adequately equipped to care for its health, there must be a ratio of convalescent beds to acute beds of at least 1 to 10. Most cities fall far short of this.

The Burke Foundation, with its beautiful convalescent home at White Plains for 300 patients, recruited from the poor of New York City, has set an example which all communities should emulate, so far as is possible.

The historical portions of this book are interesting and valuable, while the practical suggestions made, if carried out, will do much to correct the faults which may now justly be found with our system of rehabilitation.

TOBACCO AND PHYSICAL EFFICIENCY, by *Pierre Schrumpf-Pierron, M. D., Professor of Clinical Medicine, University of Cairo.* Paul B. Hoeber (Inc.), New York, 1927.

This little book, published under the auspices of the committee to study the tobacco problem, does not attempt to settle the question of the harmfulness or harmlessness of tobacco used in moderation.

The action of tobacco on the various systems of the body, as stated by numerous investigators, is given.

The greatest value of the book lies in the annotated bibliography—of 70 pages—with which it closes. Anyone desirous of carrying further his reading on the subject will find here references to the literature of the world.

INTERNATIONAL CLINICS, VOLUMES III AND IV, THIRTY-SEVENTH SERIES, 1927. Edited by *Henry W. Cattell, A. M., M. D.* J. B. Lippincott Co., Philadelphia.

Volume III of this well-known quarterly contains several articles of unusual merit, such as "Colitis," by Thomas R. Brown, of Baltimore; "Clinical aspects of thrombo-angiitis obliterans," by William

A. Steel, of Philadelphia; "Medical treatment of peptic ulcer," by John Phillips, of Cleveland, Ohio.

The major part of Volume IV is devoted to travel clinics, a series of clinical lectures delivered before the members of the 1927 European Interstate Postgraduate Medical Association of North America, by distinguished clinicians of Great Britain, Germany, Denmark, Norway, and Sweden. Many of them are valuable.

Harlow Brooks, of New York City, contributes a timely paper on "The treatment of the pneumonia patient."

An interesting feature of both volumes is the medical questionnaire, in which Doctor Cattell answers questions which have been submitted by readers.

# THE DIVISION OF PREVENTIVE MEDICINE

Commander M. A. STUART, Medical Corps, United States Navy, in charge

## NOTES ON PREVENTIVE MEDICINE FOR MEDICAL OFFICERS, UNITED STATES NAVY

### GENERAL CONSIDERATIONS ON AMŒBIC DYSENTERY AND ENDAMŒBIC CARRIERS, FROM THE VIEWPOINT OF A NAVAL SURGEON

By M. A. STUART, Commander, Medical Corps, United States Navy

It appears to be generally conceded that Lösch first noted the presence of amœbæ in feces in 1875. They were regarded as nonpathogenic, however, until Koch, in 1883, found them in intestinal ulcers. Schaudinn, who, in 1903, published his observations of the amœbæ found in the human intestine, was the first to appreciate clearly that two distinct species exist, the one harmless and the other pathogenic to man. These observations have been supported by the work of Craig and many other investigators subsequently.

While amœbic dysentery is prevalent almost generally throughout the Tropics, it is not limited to a hot climate but appears to have a world-wide distribution and to exist wherever there are human beings. Though not a common disease in the Temperate Zone, it has been recognized in northern Europe, North China, South Africa, Australia, and as far south as Paraguay in South America. The patient observed by Lösch in 1875, the first case of amœbic dysentery ever recorded, was a native of northern Russia.

*Geographical distribution.*—Reports published by various American authors during the several years prior to the World War indicated a wide distribution and a relatively common occurrence of amœbic infections in the United States. These publications corroborated the view that protozoan infections are not confined to the Tropics, but may occur in countries farther north, even as far as Alaska, as shown by Axtell in 1911. His patient, a mate on a Yukon River steamer, was presumed to have contracted the infection through the use of swamp water carried into the river during the spring freshets. He gave a history of frequent, painful, mucous, and bloody stools, and a sigmoidoscopic examination revealed many ulcerations of the lower bowel. Mucus removed from the ulcers revealed large

numbers of amœbæ reported as *Amœbæ coli*. The patient claimed that he knew of 13 or 14 other persons that had similar symptoms.

Observations made in recent years have shown a wide distribution of *Endamœba histolytica* carriers throughout the United States as well as in other parts of the world outside of the Tropics. Competent observers have found from 4 to 18 per cent of the individuals examined infected with *E. histolytica*. Its presence has also been shown in France to about the same extent. Its distribution in Europe extends, as has been noted, as far north as northern Russia and it is prevalent to a greater extent in the Balkan States. Amœbic dysentery and its complications are, however, not generally recognized as common diseases in the more temperate climates, the disease becoming more frequent and more serious as the tropical and subtropical areas are approached. It has been noted by many observers that patients who have contracted amœbic dysentery in the Tropics have frequently improved greatly after a change of residence to a colder climate.

A diagnosis of amœbic dysentery recently made in the cases of several hundred ex-service men residing in the State of Minnesota has brought up the question of the incidence of amœbic dysentery in the United States.

Patterson (1909) reported 3 cases of amœbic dysentery in New York City and stated that other observers had reported cases as follows: Brannon, 1893, 1 case; Graser, 1900, 2 cases; Brooks, 1900, 12 cases; and Libman, 1902, 10 cases. Of these 28 individuals, 1 was a Russian immigrant who stated that he had been a resident of the United States for six years, 1 had been a sailor, in 10 the probable source of infection was not given, and in the remaining 16 the infection was thought to have been acquired in the vicinity of New York City.

This author gives the geographical distribution of other cases reported up to the year 1909, as to the probable place of infection, as follows: Winnipeg, Canada, 1 case; Maine, 1; New Hampshire, 1; New York, 3; Pennsylvania, 8; District of Columbia, 3; Virginia, 15; West Virginia, 8; North Carolina, 5; South Carolina, 3; Georgia, 40; Florida, 4; Tennessee, 3; Alabama, 7; Mississippi, 1; Ohio, 1; Illinois, 3; Missouri, 11; Michigan, 1; Minnesota, 2; Montana, 1; Arkansas, 1; Oklahoma, 1; and Texas, 21. One case thought to have been infected in the State of Maryland was reported in 1890, and later a number of cases have been noted by other observers.

Long (1909) reported 4 cases of amœbic dysentery occurring in 1907 and 1908, in which the disease appeared to have been contracted in San Francisco, Calif. In one instance it was stated that the patient had never been out of the city. As a result of this observa-

tion, he later reported 40 cases occurring in the period from December, 1908, to June, 1909. Of these, he believed that the infection had been acquired within the United States in 14 instances. In 1918, Gunn reported 21 cases of amœbic dysentery, of which 9 were thought to have been contracted in California.

Cort and McDonald (1919) regarded the evidence sufficient to show that amœbic infection is frequently contracted in California and that carriers exist. Within this State there are large numbers of persons, many of whom are undoubtedly carriers, that have immigrated from Japan, China, India, Hawaii, the Philippines, and countries where the disease is prevalent. A large number of these engage in agriculture in the form of truck gardening, or become cooks or domestic servants.

Rosenberger (1913) examined the feces of 278 patients of the Philadelphia Hospital for the Insane and found amœbæ in 193, but apparently did not differentiate between *E. coli* and *E. histolytica*. There were no symptoms of dysentery in any case, and but one showed macroscopic blood in the stools.

Sistrunk (1911) reported that the feces of 110 patients with chronic diarrhea, anemia, or inexplainable abdominal conditions, and 35 with other symptoms or conditions, a total of 145, were examined at the Mayo clinic during the preceding four and one-half months. *E. tetragena*, a pathogenic amœbæ now considered to be identical with *E. histolytica*, was found in the feces of 16 of the patients and *E. histolytica* in 9. The patients, in 7 of the cases in which *E. tetragena* were found and in 1 with *E. histolytica*, stated that they had never been south of the State of Iowa. A patient, who claimed that he had never been out of the State of Minnesota and had had chronic diarrhea for 8 or 10 years, was found to be infected with *E. tetragena*, together with three other types of protozoa. Eight of the 9 patients showing *E. histolytica* gave histories of having been in the Southern States or Tropics prior to the onset of symptoms, while the ninth stated that he had not been out of the State of South Dakota.

In a later article regarding the experience at the Mayo clinic, published by Griffin (1913), he stated that the examination of the stools in certain cases has led so frequently to the identification of endamœbæ that they had come to consider such infections relatively common.

The stools of 1,700 patients were examined at the Mayo clinic for parasites over a period of two and one-half years terminating in 1913 and amœbæ were found in 227, or 13.3 per cent. The amœbæ were identified as *E. coli* in 148 cases and as *E. tetragena* or *E. histolytica* in 79 cases, or 4.6 per cent. The histories of 41 of the

79 patients indicated that the infection had been acquired while residing in one of the North Central States, as follows: Minnesota, 14; Iowa, 12; North Dakota, 5; South Dakota, 5; Nebraska, 2; Wisconsin, 2; and Montana, 2. The intestinal symptoms experienced by these patients varied considerably. Thirty-five of the 41 gave a history of diarrhea, although it was the chief complaint of but 24, and of these 13 had had, at one time or another, severe attacks of diarrhea, with more or less blood in their stools. As nearly as could be judged, however, these attacks were not so violent as those in cases reported from the South. On the other hand, most of the patients gave a history of more or less constant diarrhea of a mild type, also quite in contrast to the southern cases. More than one-half of the patients gave a history of the passage of macroscopic blood at one time or another in the course of their disease.

It should be borne in mind, however, that the persons whose stools were examined in this study had symptoms of a disease or condition severe enough to cause them to seek relief at a hospital, and many of them doubtless had been referred to the Mayo clinic because their disease or condition had not been cured or alleviated by treatment received at or near their homes.

According to Sanford (1916) the feces of about 5,000 patients had been examined for intestinal parasites at the Mayo clinic during the preceding five years. Craig's descriptions were used in classifying the amœbæ found and, in some instances, the specimens were stained by the iron hematoxylin method.

The *E. histolytica* was identified in the stools of 535, or 10.7 per cent, of the 5,000 patients, and the *E. coli* in 284. The majority of these patients came from rural communities, were natives of the State in which they resided, and apparently had never been in contact with persons having tropical infections. All of them became infected while living in the northern portion of the Temperate Zone. In addition to the northern cases, 95 patients from the South or the Orient, in whose stool amœbæ had been found, were used as "controls" for the purpose of comparing the severity of the symptoms produced. Of these patients, 65 were infected with *E. histolytica* and 30 with *E. coli*, so that of the total 5,000 patients examined for parasites, amœbæ were found in 18 per cent, of which number 41 per cent had a constant diarrhea, 33 per cent an intermittent diarrhea, often alternating with periods of constipation, and nearly 26 per cent had experienced no other bowel trouble except constipation. An occasional patient presented ulcerations that were seen with the proctoscope, but most of such examinations were negative.

The distribution of the cases of amœbic infection found at the Mayo clinic were as follows:

*Cases of amœbic infection*

| Northern States and Canada | Constant diarrhea | | Intermittent diarrhea | | Constipation | | Total | | Total amœbæ |
|---|---|---|---|---|---|---|---|---|---|
| | E. histolytica | E. coli | E. histolytica | E. coli | E. histolytica | E. coli | E. histolytica | E. coli | |
| Minnesota | 51 | 34 | 38 | 33 | 44 | 29 | 133 | 96 | 229 |
| Iowa | 41 | 10 | 42 | 15 | 30 | 27 | 113 | 52 | 165 |
| South Dakota | 30 | 8 | 23 | 9 | 5 | 15 | 58 | 32 | 90 |
| North Dakota | 25 | 5 | 8 | 4 | 10 | 12 | 43 | 21 | 64 |
| Wisconsin | 16 | 3 | 11 | 6 | 8 | 4 | 35 | 13 | 48 |
| Illinois | 8 | 1 | 7 | 2 | 9 | 8 | 24 | 11 | 35 |
| Michigan | 6 | 0 | 4 | 1 | 1 | 4 | 11 | 5 | 16 |
| Indiana | 1 | 1 | 4 | 3 | 2 | 0 | 7 | 4 | 11 |
| Ohio | 2 | 1 | 1 | 0 | 1 | 1 | 4 | 2 | 6 |
| Kansas | 1 | 1 | 3 | 2 | 0 | 2 | 4 | 5 | 9 |
| Nebraska | 9 | 2 | 3 | 4 | 4 | 3 | 16 | 9 | 25 |
| Wyoming | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 3 | 5 |
| Colorado | 1 | 0 | 1 | 0 | 0 | 1 | 2 | 1 | 3 |
| Montana | 8 | 3 | 12 | 4 | 7 | 3 | 27 | 10 | 37 |
| Idaho | 1 | 1 | 0 | 1 | 1 | 0 | 2 | 2 | 4 |
| Utah | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 2 |
| Oregon | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 2 |
| Washington | 2 | 0 | 3 | 0 | 1 | 0 | 6 | 0 | 6 |
| New York | 1 | 0 | 0 | 1 | 2 | 1 | 3 | 2 | 5 |
| Pennsylvania | 1 | 1 | 0 | 1 | 1 | 0 | 2 | 2 | 4 |
| Massachusetts | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| New Hampshire | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| Maine | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Saskatchewan | 8 | 0 | 6 | 2 | 4 | 2 | 18 | 4 | 22 |
| Manitoba | 5 | 1 | 3 | 2 | 2 | 2 | 10 | 5 | 15 |
| Alberta | 3 | 0 | 2 | 1 | 3 | 1 | 8 | 2 | 10 |
| Ontario | 1 | 0 | 2 | 0 | 0 | 0 | 3 | 0 | 3 |
| Total from North | 224 | 75 | 175 | 92 | 136 | 117 | 535 | 284 | 819 |
| Total number of patients, 1911–1916 Southern States and Tropics | 20 | 4 | 20 | 12 | 25 | 14 | 65 | 30 | 95 |
| Total | | | | | | | 600 | 314 | 914 |

In this series of 914 cases in which amœbæ were found, 40 per cent of the patients, including those from the South and the Orient, stated that the water supply used by them was from a source questionable as to purity, such as shallow wells, lakes, springs, cisterns, reservoirs, streams, and, in a few instances, even ditches. On the other hand, 60 per cent of the patients stated that their water supply came from good, deep wells, many of which were of the artesian type.

A report by Smithies (1918) from a study of records of the last 1,000 stool examinations in his clinic indicated 93 instances of protozoal infections. The ages of the patients ranged from 7 to 82 years, with an average age of 39 years. Of these, 52 were of Scandinavian birth or extraction, and the remainder were of American, German, Irish, Russian, Austrian, or English origin.

The geographical distribution by States was as follows: Illinois, 29; Iowa, 16; Wisconsin, 13; Nebraska, 8; Michigan, 7; Minnesota, 6; Indiana, 4; South Dakota, 2; Arkansas, 2; Ohio, 2; Texas, 2; Kentucky, 1; and Northern California, 1. It may be noted that but 4 patients came from regions south of the State of Illinois. While there were 11 patients who stated that they had made occasional

trips for business or pleasure to the Southern States, there were 78 who claimed that they had never been south of Illinois. Shallow dug wells, presumably contaminated springs, sluggish weed-grown rivers, ponds, or lakes, befouled by sewage or drainage systems, were given as the source of the water supply in 78 instances, while in the remaining 15 cases the drinking water was obtained from apparently good sources. In the 93 cases of protozoal infections reported in the foregoing, the *E. histolytica* was identified in 17 cases and *E. tetragena* in 6, while in 4 cases the endamœba was reported as unclassified.

*Epidemiology.*—The infecting agent of amœbic dysentery, the *E. histolytica*, is regarded as a tissue parasite of man. Infection is brought about by ingestion of the encysted forms first described by Quincke and Roos in 1893. Grassi has recognized the cysts of *E. coli* even earlier than this.

Byam and Archibald (1922), in their recent work, regard amœbic infection as a condition that is not, as a rule, distinctly harmful to man, notwithstanding the fact that the amœbic diseases may be severe and even fatal. Amœbic disorders are not, while they last, infectious, although the infection which causes them is, of course, readily communicable from man to man. The sick man is looked upon as the exceptional host who reacts pathologically to his parasites, but is of no danger to his fellow man. The healthy man, on the other hand, the carrier who lives in equilibrium with his amœbæ, and who suffers from no symptoms, is regarded as the real source of danger, for by transmitting his infection to other men he communicates a condition, which in a susceptible subject may develop into one of the most severe disorders and even terminate fatally. Under natural conditions they can not, while still in the amœboid stage, transmit an infection, and consequently the pathological states which it may entail, from one man to another. The infective forms of the parasite are its cysts. The convalescent carrier is the susceptible individual who has suffered and may continue to suffer, intermittently, from his infection. He probably is preeminently unhealthy, is subject to relapse, and in need of treatment. The contact carrier, however, is clinically a healthy man. He may develop symptoms at any time, but if he has withstood his infection in the past the probability is that he will continue, under ordinary circumstances, to do so in the future.

According to Wenyon (1926), the small precystic and encysted forms are passed together in the stool in some cases, while in others only the amœbæ or only the cysts are passed. In view of the recent successful culture of *E. histolytica* by Boeck and Drbohlav (1925) in egg media, it appears possible that the amœbæ may actually live and multiply on the surface of the intestine without giving rise to lesions. It may possibly be that the infection of many symptomless

carrier cases is of this type, and that the precystic amœbæ and cysts are produced by amœbæ living on the surface of the mucosa.

An individual who is in the carrier condition may at any time revert to one of acute amœbic dysentery. An infected person frequently suffers from periodic attacks of acute amœbic dysentery when only the large tissue-invading forms are present in the stool. Between the attacks, when the acute symptoms have abated, the carrier condition maintains when precystic amœbæ and cysts are passed. Certain individuals become infected without suffering from acute dysentery, the infection being detected only as a result of microscopic examination of the feces.

It is stated by Byam and Archibald that tolerance to *E. histolytica* infection, as distinct from infectibility, is the rule with human beings and that the average person who acquires an infection becomes a carrier, living in comparative peace with his parasites. At present, they state, it can only be said with certainty that the majority of infected individuals are "healthy" carriers who do not, and probably will not, suffer from amœbic dysentery.

Ash, of the United States Army (1923), believed there is no evidence at present to indicate that persons suffering with acute amœbic dysentery are able to transmit the disease to other persons, and that further dissemination is brought about by persons who may never have had the slightest dysenteric symptoms but who are discharging daily large numbers of cysts in their feces.

He is of the opinion that we have no criteria for determining whether any particular infected person will show dysenteric or hepatic symptoms early or whether he will remain a healthy carrier for an indefinite period of time, even though statistical data would seem to indicate that the incidence of acute dysentery in persons infected with *E. histolytica* is very low. The mere fact that a person may harbor *E. histolytica* for years and experience no ill effects therefrom is no criterion that the cysts he has discharged, and which have found their way into the alimentary tract of another person, may not promptly set up acute symptoms of one kind or another in the second person. He is also of the opinion that the proportion of persons infected with *E. histolytica* who develop amœbic dysentery is comparatively slight, probably in the neighborhood of 10 per cent.

Surg. C. H. Lavinder, United States Public Health Service (1927), states that in most cases a biologic equilibrium is established between host and parasite, and the host becomes simply a carrier without apparent disturbance of his health. In the carrier state, the organism (*E. histolytica*) is discharged in its encysted infectious form. If the equilibrium is disturbed, the parasites damage or destroy the tissues to such an extent as to produce pathologic effects, and the illness takes

the form of an ulcerative colitis. The patient then suffers from amœbic dysentery, or under more favorable circumstances, simply an amœbic diarrhea.

From the foregoing evidence it will be noted that acute amœbic dysentery is the outcome of an incompatibility between the exceptional individual and the amœbæ with which he has become infected. In regard to the so-called "epidemics" of amœbic dysentery which are from time to time reported, Byam and Archibald state that they should be regarded with suspicion, as they clearly result from the confusion of amœbic with other forms of dysentery. This has been demonstrated on many occasions. When many cases of amœbic dysentery occur simultaneously in a localized area it can only mean that the patients have acquired, directly or indirectly, their infections from some common sources at the same time, and it further implies that, in the area in question, there must be a much larger number of carriers of *E. histolytica* than of cases of amœbic dysentery.

In regard to outbreaks in the Philippine Islands, Ash states that in every instance where an epidemic of amœbic dysentery was believed to exist it was shown to be the product of the combination of incorrect diagnosis and bacillary dysentery of a mild type. He reported a so-called "epidemic" of amœbic dysentery that occurred at one of the Army posts in the Philippine Islands. Starting with a constantly high incidence of gastrointestinal disorders of various types, which included from 10 to 50 cases of dysentery a month and showed a distinct seasonal variation, the outbreak finally reached a peak when 150 cases of dysentery appeared in a single month. After an investigation, he considered the outbreak as due to a bacillary infection complicated, in some cases, by an infection with the *E. histolytica*.

*Infectibility experiments.*—Musgrave and Clegy, working in the Philippine Islands, concluded, after feeding cultures of amœbæ grown in symbiosis with bacteria harmless to animals, that the period of incubation for animals was from 20 to 70 days. Colonic injections produced focal lesions containing amœbæ as early as the second day. Three gelatin capsules, filled with a material from a three-weeks-old culture of amœbæ in symbiosis with a bacterium proved harmless to man and animals, were given to a healthy man who had been under observation for a period of 10 days. Diarrhea and the finding of active amœbæ in the stools were noted on the twelfth day after the capsules were ingested.

E. L. Walker, also working in the Philippine Islands, attempted to infect 20 men with *E. histolytica*, but succeeded in infecting only 18, 1 of whom became parasitized only after the third attempt. Amœbæ were recovered from their stools in time periods varying

from 1 to 44 days after being fed with the infected material, with an average time of 9 days. Only 4 of these infected individuals had subsequent attacks of dysentery, although they were kept under observation for a considerable time. These attacks occurred on the twentieth, fifty-seventh, and ninety-fifth days after the infected feeding. All that can be concluded with certainty from these experiments is that an infection with *E. histolytica* is usually established within a few days after swallowing the cysts of the parasite, and that thereafter the parasitized person may or may not suffer from amœbic dysentery or other amœbic disorder at any time, the period between infection and the appearance of clinical signs of disease being too indefinite to be estimated even approximately for the average case.

Kofoid, Komhauser, and Plate (1919) were the first to report examinations for intestinal protozoan infections in American soldiers who had served in France or who had remained in this country. They stated that examinations of the feces of 1,200 men of the United States Army who had been in overseas service, and of 300 men from home service troops, were carried out at the Army laboratory, Port of Embarkation, New York, since December 28, 1918. The overseas troops examined were sick and wounded soldiers in transit through Debarkation Hospital No. 3, New York City, and included men who had seen service in Flanders, Chateau-Thierry, the Argonne, and Toul regions, as well as a number from France who had never reached the front. They were drawn from 584 different regiments and other organizations, and were therefore fairly representative of our overseas troops. They came from every State in the Union and constituted approximately a fair example of our population. Only a small fraction of them had seen service on the Mexican border. It is obviously impossible to determine what proportion of the infections detected in them were acquired overseas and which were of home origin.

The home service troops were mainly cooks, bakers, and food handlers from the port of debarkation and principally from the Medical Department. Of the total of 300 men examined, 82, or 27 per cent, bear foreign names suggestive of Russian, Polish, Italian, or Spanish origin, and at least seven were negroes from Florida. This group, therefore, was less typical of the American troops as a whole than the overseas group examined. They presumably presented a higher degree of infection by reason of their origin than would a fair sample of our population. Only a single examination was made in most instances. Two or more samples were secured for examination in 36 (3 per cent) of the men examined from overseas and in 32 (16.7 per cent) of the home service troops.

In estimating the significance and value of these results regarding carriers of amœbic dysentery the following circumstances should be considered:

1. In all cases of infection by *Endolimax nana*, a small tetragenous intestinal amœba of man, described by Wenyon and O'Connor as *Entamœba nana*, this infection was differentiated from the *E. histolytica*. It was found to be a very common intestinal parasite and was demonstrated in the feces of 27.1 per cent of the overseas troops and in 30.7 per cent of the home service troops. There is some evidence in figures in the voluminous earlier literature that this amœba has, in some instances, been confused with the true dysenteric amœba. The possibility of such confusion renders previous reports of carriers of *E. histolytica* in this country and elsewhere tentative and subject to revision. This applies to determinations on both cysts and free amœbæ, for the cysts are tetragenous and the latter have ectoplasmic pseudopodia, as has *E. histolytica*.

2. There has been little, if any, selection of cases for examination. The data represented the average run of the sick and wounded men received at Debarkation Hospital No. 3. They were not, as a rule, dysenteric patients, though many of those carrying cysts of *E. histolytica* gave a history of one or more attacks of diarrhea or dysentery, in some cases with sick call attendance and treatment, while on the western front. There were some instances of infection by *E. histolytica* with no previous record of intestinal disorder. This was often the case in the infections among home service troops.

3. In only a small percentage of cases was more than one examination made. Continued examination for six successive days, as recommended by Dobell, would unquestionably increase the number of infections detected. Results in Great Britain indicate that approximately one-third of the cases detected on six successive examinations may be detected by experienced examiners on the first examination.

Examination of the feces of 1,200 men who had served overseas revealed the presence of *Endamœba coli* in 328 instances, or 27.3 per cent; *Endolimax nana* in 325, or 27.1 per cent; *End. histolytica* in 130, or 10.8 per cent ; and *End. gingivalis* in 1, or 0.1 per cent. Examination of feces of 300 men of the home service troops showed *E. coli* in 61 instances, or 20.3 per cent; *E. nana* in 92, or 30.7 per cent; *E. histolytica* in 9, or 3 per cent; and *E. gingivalis* in 1, or 0.3 per cent.

In 1920, Kofoid and Swezy reported a total of 2,300 overseas and 576 home service troops, including those previously reported, that had been examined for protozoan infections. They found *E. histolytica* in the feces of 297, or 12.8 per cent, of overseas troops and in the feces of 25, or 4.3 per cent, of the home service troops.

In the "History of the Medical Department of the United States Army in the World War" there were reported from July 1, 1917, to April 30, 1919, 6,195 cases of dysentery. Of these, 934 cases presented laboratory proof of diagnosis. Only 38 of these were amœbic, and 896 were due to one or more of the dysentery bacilli. Of the amœbic cases the majority gave history of a previous attack or of residence in United States or in the Tropics where the disease was known to have been prevalent.

No cases of infection probably acquired from local French civilian sources were reported. Amœbic and bacillary dysentery were fairly common in all parts of France but no serious epidemics or foci of either kind were reported in French civil or military population during the period under discussion. Of our soldiers who went to Europe and suffered attacks of dysentery, the great majority of them probably had the bacillary rather than the amœbic type, and when one of these soldiers, who proved to be a carrier of *E. histolytica*, gave a history of dysentery while in France, that history might involve either of two possibilities—that the dysentery was due to amœbic infection or, what is more probable, that the attack was one of bacillary dysentery with concurrent or later amœbic infection.

An examination of the morbidity records of the Navy and Marine Corps personnel serving in Europe during the World War shows a total of 528 cases of dysentery, unclassified, that occurred while overseas. Most of these cases were among men in the active war areas of France and were regarded as of bacillary origin. Two cases of amœbic dysentery, in which *E. histolytica* were found in the stools of the patients, were recorded as developing in men serving in Europe. In one case the infection was regarded as having been acquired while the man was on duty at the Lafayette radio station, and in the other case a marine was evacuated from the Chateau Thierry sector as with dysentery, unclassified. This diagnosis was later changed to acute catarrhal gastroenteritis and inscribed in his health record some time later as amœbic dysentery. He was returned to duty after 12 days' treatment and, as there was no recurrence, the disease was very probably of bacillary origin.

While naval personnel sent to training stations in the Southern States may have been exposed to infection with *E. histolytica*, it is more probable that they were infected through hazards existing outside the stations or at their homes. If infection was acquired by men at these stations, the carrier stage, without causing symptoms requiring their admission to the sick list, probably resulted. The records from all training stations in the United States show that only two men were admitted for amœbic dysentery during the period of the World War, and in both instances the infection was reported

as having been acquired prior to enlistment. Symptoms developed while the men were on duty in the vicinity of Norfolk, Va.

The records from United States Navy recruiting stations for the years 1917 and 1918 show that two individuals were rejected for dysentery. One applicant for original enlistment was rejected at the recruiting station, Des Moines, Iowa, and one applicant for reenlistment at San Francisco, Calif. It was manifestly not practical during the period of the World War to examine the stools of every recruit for the presence of amœbæ at the time of enlistment or training.

The following table gives the number of cases of amœbic dysentery reported for the entire Navy for the years 1917 to 1926, inclusive:

| Year | Number of admissions | Rate per 100,000 | Invalided from the service | Continued to next year |
|---|---|---|---|---|
| 1917 | 67 | 27 | 1 | 8 |
| 1918 | 94 | 19 | 3 | 15 |
| 1919 | 48 | 16 | 7 | 4 |
| 1920 | 25 | 18 | 3 | 5 |
| 1921 | 38 | 26 | 2 | 9 |
| 1922 | 47 | 38 | 3 | 12 |
| 1923 | 47 | 40 | 3 | 1 |
| 1924 | 39 | 33 | 0 | 6 |
| 1925 | 42 | 36 | 3 | 8 |
| 1926 | 39 | 34 | 0 | 6 |
| Total | 486 | 25 | 25 | 74 |

The man invalided from the service in 1917 developed symptoms of dysentery within a month after enlistment, and gave a history of similar attacks prior to entry into the service.

The records show that most of the cases of amœbic dysentery reported during the period of the World War developed in men serving in tropical countries, such as the Philippine Islands, Haiti, and Nicaragua.

A sorting of the Form F cards returned from all naval training stations for the years 1924, 1925, and 1926 showed but one person with less than one year's service admitted with amœbic dysentery. This patient, a seaman of 11 months' service and a native of the State of Mississippi, was reported from the naval training station, Hampton Roads, Va., in August, 1924.

An examination by Boeck and Stiles (1923) of the feces of 711 southern naval recruits stationed at the United States training camp, Gulfport, Miss., showed 3.7 per cent of them infected with *E. histolytica*. It was also found tnat 138 of them had hookworm infections. No case of amœbic dysentery, however, was reported from this camp.

The Public Health Service completed an investigation on the possible bearing of the World War in the spread of zooparasitic

infections, especially amœbic dysentery, in June, 1921. Stiles states that during this study, hospitals and other institutions, 48 in number and located in 22 States and in the District of Columbia, furnished specimens of feces from 8,029 persons, of whom 2,584 were soldiers who had not served in Europe, 3,536 had served in Europe, 1,547 were persons who had had no military service, and 362 were persons of unknown military status.

The number of persons, expressed in per cent of the total examined in each class, found infected with the various intestinal protozoa is shown in the table which follows:

*Distribution of protozoan infections found in 8,029 persons in the United States*

| War service | Total persons | Examinations | | E. coli | | E. nana | | E. histolytica | | E. williamsi | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Average number per capita | Cases | Per cent persons examined | Cases | Per cent persons examined | Cases | Per cent persons examined | Cases | Per cent persons examined |
| Home | 2,584 | 3,546 | 1.3 | 525 | 20.3 | 323 | 12.5 | 93 | 3.5 | 157 | 6.0 |
| Foreign | 3,536 | 4,146 | 1.1 | 466 | 13.1 | 423 | 11.9 | 100 | 2.8 | 148 | 4.1 |
| None | 1,547 | 4,801 | 3.1 | 536 | 34.6 | 280 | 18.0 | 129 | 8.3 | 83 | 5.3 |
| Unknown | 362 | 550 | 1.5 | 59 | 16.2 | 34 | 9.3 | 11 | 3.0 | 16 | 4.4 |
| Total | 8,029 | 13,043 | 1.6 | 1,586 | 19.6 | 1,060 | 13.2 | 333 | 4.1 | 404 | 5.0 |

| War service | Vahlkampfia | | Unencysted amœba | | Chilomastix | | Trichomonas | | Giardia | | Others | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cases | Per cent persons examined | Cases | Per cent persons examined | Cases | Per cent persons examined | Cases | Per cent persons examined | Cases | Per cent persons examined | Cases | Per cent persons examined |
| Home | 9 | 0.3 | 170 | 6.5 | 82 | 3.1 | 2 | ------ | 157 | 6.0 | ------ | ------ |
| Foreign | 8 | .2 | 269 | 7.6 | 54 | 1.5 | 1 | ------ | 197 | 5.5 | 1 | ------ |
| None | 11 | .7 | 108 | 6.9 | 106 | 6.8 | 3 | 0.2 | 149 | 9.6 | 1 | ------ |
| Unknown | 2 | .5 | 10 | 2.7 | 14 | 3.8 | ------ | ------ | 19 | 5.2 | 1 | ------ |
| Total | 30 | .3 | 557 | 6.9 | 256 | 3.1 | 6 | ------ | 522 | 6.5 | 3 | ------ |

Of the 8,029 persons examined, 333, or 4.1 per cent, showed the parasite of amœbic dysentery in their feces, on a basis of 1.6 stool examinations per person, as follows:

(*a*) Of 196 immigrants at Ellis Island, a single examination in each case showed 17 persons infected, or 8.6 per cent.

(*b*) Of 329 American boys and girls in a training school in the District of Columbia, an average of 5.2 examinations in each case showed 57 individuals, or 17.3 per cent to be infected.

(*c*) Of 1,547 civilians with no military service, an average of 3.1 examintaions in each case showed 120 persons, or 8.3 per cent, affected.

(*d*) Of 83 American boys and girls in training school in the District of Columbia, an average of 5.5 examinations for each case showed 10 persons, or 12 per cent, infected.

(*e*) Of 2,584 soldiers that did not see service in Europe, an average of 1.3 examinations revealed 93 men infected, or 3.5 per cent.

(*f*) Of 3,536 soldiers returned from Europe, an average of 1.1 examinations showed 100 infected, or 2.8 per cent.

(*g*) Of 362 persons of unknown military service, an average of 1.5 examinations showed 11 persons, or 3 per cent, infected.

These soldiers were examined on an average of slightly more than once per person. The much larger incidence of infection for *E. histolytica* found in the persons with no military service was due to two factors. First, most of them were from two training schools for boys and girls and from an asylum. Institutional life in general is conducive to the spread of protozoan infections. Second, an average of three examinations per person was made of the feces from the persons with no military service. Had the home service and foreign service cases been examined the same number of times it is probable that their rates of infection would have increased to about 6 per cent or more.

As a result of the survey, the incidence of *E. histolytica* among patients at the Public Health hospitals in the various States was found to be as follows: Hospital No. 55, New Mexico, 5.5 per cent; Hospital No. 34, Boston, Mass., 4.1 per cent; No. 9, New Mexico, 3.4 per cent; No. 56, Maryland, 3.1 per cent; No. 27, Louisiana, 3 per cent; No. 53, Illinois, 2.9 per cent; No. 32, District of Columbia, 2.7 per cent; and No. 50, Arizona, 2.6 per cent. No infection with *E. histolytica* was found among the cases in United States Public Health Hospitals No. 35, in Missouri; No. 38, in New York; No. 47, in Pennsylvania; No. 48, in Georgia; and No. 58, in Louisiana. The above results would tend to show that infections with *E. histolytica* were more prevalent in States along the Mexican border and in Louisiana and Mississippi, but that they are not confined to those sections.

Carter, Mackinnon, Matthews, and Smith, 1917, examined, at Liverpool, 4,968 convalescent dysenteric patients, who came chiefly from the Mediterranean war zones, with an average of three examinations for each case, and found *E. histolytica* in 7 per cent. Smith and Matthews, 1917, examined 450 convalescent patients, without previous dysenteric symptoms, with an average of two examinations in each case, and found *E. histolytica* in 6.4 per cent, and Dobell, 1921, examined 3,146 English civilians, most of whom were examined but once, and found *E. histolytica* in 3.4 per cent. The incidence of *E. histolytica* was about the same in both the dysenteric and non-dysenteric cases and about twice as numerous as in the English civil-

ians examined. They found it difficult to estimate exactly how many soldiers were carriers of *E. histolytica* before leaving England for the war areas, but it seems probable that less than one-fourth to one-half the number of carriers discovered among the returned soldiers became infected in the Mediterranean war areas, which included Gallipoli, Egypt, and Mesopotamia, where *E. histolytica* is more prevalent than in France, and whence most of the dysenteric patients were invalided to England and later examined for intestinal protozoa while convalescing.

Dobell (1917) and others have definitely proved that a single examination of a number of cases will result in the detection of about one-third of the actual number of infections which would be uncovered were a sufficient number of examinations made to find them all and that three examinations in each case will uncover between one-half and two-thirds of all the infections.

Wenyon and O'Connor examined the stools of 1,979 healthy troops in Egypt and found that 106 were infected with *E. histolytica.* But of these 106 individuals only 16 gave any history of dysentery. And, as they point out, "It is certain that the latter figure is too high for amœbic dysentery, as in no case can we be certain of the type of dysentery from which the case suffered."

According to Manson and Bahr (1919), from observations in 1917, the causative agent in cases of amœbic infection is more readily found than in bacillary dysentery. Dysentery bacilli are detected comparatively easily in the acute cases, becoming more uncertain during subsequent days of the attack, and are rarely found in convalescents, while in cases of amœbic dysentery the amœbæ may be found after all symptoms have subsided. In patients with amœbic dysentery recurrences are common, while in the bacillary type this seldom happens in the absence of a reinfection. Boeck states, "It would seem therefore that most of the cases of dysentery occurring among the forces in Europe were of the bacillary type, otherwise amœbæ would have been found more frequently in patients returned from the war areas and giving a history of dysenteric attacks while overseas." In those that gave a history of dysentery and were proved upon return to the United States to be carriers of *E. histolytica*, there are two possibilities, either that the dysentery was due to amœbic infection or, what is more probable, that the attack was one of bacillary dystentery with concurrent or later amœbic infection. *E. histolytica* may be as prevalent among bacillary carriers as in other classes of patients. From the work of Glynn, Berridge, Foley, Price, and Robinson, 1918, who made two examinations in each case of 2,360 dysenteric convalescents and 57 carriers of bacillary dysentery, and who found *E. histolytica* in 7.4 per cent of the dysenteric convales-

cent patients and in 7 per cent of the bacillary carriers, it seems likely that the remainder of the 2,360 dysenteric convalescent patients who were found to be neither bacillary nor amœbic carriers had probably suffered from bacillary dysentery, but that the bacilli could not be isolated during convalescence.

Letters requesting information as to whether an increase of clinical amœbic dysentery had been noticed since the armistice were sent to 607 hospitals and 115 medical schools. Replies from 28 States were negative, from 3 States they were negative or indefinite, and from 13 States 24 affirmative, 8 indefinite, and 174 negative replies were received as follows:

*States reporting an increase of amœbic dysentery since the World War*

| State | Affirmative reply | Indefinite reply | Negative reply | State | Affirmative reply | Indefinite reply | Negative reply |
|---|---|---|---|---|---|---|---|
| Alabama | 2 | 0 | 4 | Ohio | 1 | 0 | 18 |
| California | 4 | 1 | 10 | Pennsylvania | 3 | 3 | 56 |
| Kansas | 1 | 0 | 5 | Texas | 4 | 2 | 5 |
| Maryland | 1 | 1 | 13 | Utah | 1 | 0 | 2 |
| Michigan | 1 | 0 | 11 | Washington | 1 | 0 | 5 |
| Minnesota | 1 | 1 | 13 | Wisconsin | 2 | 0 | 12 |
| Missouri | 2 | 0 | 20 | | | | |

In Minnesota an increase in clinical amœbic dysentery was noted in 1919 and 1920 by Patterson at the Fergus Falls State Hospital. One reply from Canada reported an increase and six stated an increase had not been noted. In at least 31 States, clinical amœbic dysentery has not increased since the armistice to such an extent that it attracted the attention of the hospitals or medical schools that replied to the inquiry.

*Transmission.*—According to Ash, it is improbable that water is concerned to any extent in the transmission of amœbic dysentery. The cysts of *E. histolytica* may live in water as long as a month. They are very sensitive to unfavorable conditions, particularly desiccation and sunlight. High bacterial concentration will destroy them in water as well as moderately high temperature. In order to bring about dissemination by drinking water there would have to be a very rich infection with cysts at its source, for sedimentation and other influences greatly reduce them. It must also be remembered that there is no increase in numbers, such as occurs in the case of bacterial contamination. It is conceivable that a well in which the water was stationary and heavily contaminated with infected material might be a source of danger, but under usual conditions it is unlikely that drinking water is a factor in spread of amœbic dysentery. The cysts of *E. histolytica* are resistant to all chemical agents that can safely be applied to drinking water.

The human carrier, so far as is known at present, is the only practicable reservoir, and dissemination is brought about by direct contact, contamination by feces of vegetables eaten raw, distribution by certain arthropod vectors, as flies and cockroaches, and possibly by the use of infected water.

The recent work of Wenyon and O'Connor, 1919, shows that the cysts of *E. histolytica* apparently do not withstand drying. In the presence of moisture, however, they continue viable for a long period. They will survive at least one month in polluted water—the less concentration of sewage, the longer the survival. They found that chlorinated lime (1 part chlorine in 700,000) had no action on the cysts, and that free chlorine in 1:10,000 concentration failed to kill in four hours.

Byam and Archibald state that in large tropical towns, with up-to-date water supplies, amœbic infection should be rare; whereas in smaller towns, in villages, and around native huts and encampments, it will be common in proportion to the insanitary conditions which prevail.

Wenyon and O'Connor, 1919, fed house flies on infected feces and found living, apparently unchanged *E. histolytica* cysts during a period beginning 5 minutes after ingestion and continuing as long as 42 hours. They also examined between 200 and 300 wild flies and found about 8 per cent carrying cysts of human intestinal protozoa besides eggs of flukes, tapeworms, and nematodes, commonly parasitic in the intestines of man. Over 3 per cent carried cysts of *E. histolytica*. The flies were taken in a city where sanitary conditions were anything but good.

Stiles states that there is very little danger of the spread of *E. histolytica* infections in communities which are furnished with a sewer system and modern toilets of the flush type, since the disposal of feces is well taken care of by these means, but the danger becomes much greater wherever surface privies are in use, in which the stools are often exposed to flies which have been shown to be important factors in the spread of intestinal protozoa. Some authors, on the other hand, incriminate other factors, such as bathtubs, towels, etc.

Lynch (1915) in the course of experimental transmission of the *Trichomonas intestinalis* to rats by feeding them human feces containing these parasites, found that the large brown rat (*Rattus norwegicus*) suffers from spontaneous amœbic dysentery similar to that occurring in man. He concluded that this apparently occurs in endemic foci in Charleston, S. C.; that this rat may be infected with *E. histolytica* by allowing it to eat human feces containing this parasite; that the disease thus produced is practically the same as that occurring in man and from spontaneous infection in rats; that this

infection may be transmitted spontaneously and experimentally from the infected to the healthy rat by their close association; and that the rat is a possible and probable disseminator of dysenteric amœbæ pathogenic for man.

In regard to carriers, Scott (1924), states that the transmission by "carriers" does not explain the rare incidence of new cases of amœbic dysentery in North China during the extremely cold winter when the native servants, all potential carriers and notably careless, can and probably do spread myriads of cysts over food and dishes. Although there were recurrences, he did not recall seeing or hearing of a new case of amœbic dysentery during the winter of 1920–21 in Tientsin, China, either in the military or the foreign civilian population. Nichols (1922), however, states that from the point of view of the parasite, the transmission of the disease (amœbic infection) is due to a carrier stage in 100 per cent of instances.

*Diagnosis.*—It is practically impossible and certainly not safe to make a differential diagnosis between bacillary and amœbic dysentery on clinical grounds alone. In the stool of uncomplicated amœbic dysentery both blood and mucus are present, but other cellular elements are very scant, the microscopic picture being made up largely of erythrocytes. Cells of the mononuclear type tend to predominate over the polymorphonuclear leucocytes, which are relatively few in number. Charcot-Leyden crystals are of frequent occurrence in the stools of patients having amœbic dysentery. *E. histolytica*, containing ingested erythrocytes, appear in stools only when some active ulcerative process is present somewhere in the colon. Wenyon states that Thomson, J. G. (1918), and Acton (1918) drew attention to the frequent presence of Charcot-Leyden crystals in the stools of amœbic dysentery cases, and the latter observer concluded that their presence was pathognomonic of an infection with *E. histolytica.* Thomson, J. G., and Robertson (1921) have published an account of observations which tend to confirm the earlier conclusions. It is possible that Charcot-Leyden crystals appear in any chronic ulcerative condition of the large intestine and that their association with *E. histolytica* is a result of the amœba being the most frequent cause of such a condition.

Amœbæ, both in feces and in sections of intestinal ulcers and liver abscess, especially in cats, may contain numerous irregularly shaped bodies which appear to be chromotoid in nature. Sometimes they bear some resemblance to Charcot-Leyden crystals.

Ash, in reporting an outbreak of amœbic dysentery in the Philippine Islands, stated that a comparison of laboratory findings with the clinical data led to the conclusion that some of these men suffered from bacillary dysentery, and that the endothelial macrophages were identified as *E. histolytica*, no significance having been placed upon

the general microscopical characters of the stools. The presence of other species of amœbæ, Blastocystis and the like, may have led to confusion here. *E. coli* were recorded twice, while his own observations showed *E. coli* in from 10 to 26 per cent of the cases.

Again, according to Wenyon, some observers have attempted to discover a means of diagnosis in the microscopical appearance of the cells in the stools of amœbic dysentery cases, but apart from the amœba, there is nothing characteristic of the condition. As a rule there occur a certain number of cells, including degenerating epithelial cells, macrophages which have been discharged from the ulcers, and some pus cells. They are usually present in comparatively small numbers, and it is only rarely that the stool contains the enormous numbers of cells usually seen in acute bacillary dysentery.

In many cases it is impossible to decide whether the symptoms noted are due entirely to the amœbæ, or whether they are partly the result of secondary bacterial infection of the already damaged tissues. It would be expected that an ulcerated intestine, though producing no symptoms, would be more liable than a healthy one to be irritated by food or bacteria, and if diarrhea results from such irritation it is difficult to affirm that it is due to the amœbæ, though many may appear in the stool.

If a section of the wall of an amœbic abscess is examined, it will be seen that there is a gradual transition from normal tissue to the completely necrotic area on the surface of the abscess wall. The amœbæ are found to be most numerous in what may be called the intermediate zone. On this account the examination of the pus which first discharges from an amœbic abscess of the liver may reveal no amœbæ. After a day or two, when apparently the surface of the abscess is breaking away and being discharged, amœbæ may appear in the discharge in large numbers. These amœbæ have the same character as the larger forms found in the intestinal ulcers.

Haughwout, of the Philippine General Hospital (1919), stated that mixed infections of bacilli and *E. histolytica* are common in the Philippine Islands and that members of the staff of the Philippine General Hospital are not in entire accord with authors who hold that endamœbic dysentery does not become complicated by invasion of the amœbic ulcers in the intestinal wall by bacteria other than *Bacillus dysenteriæ* with consequent evidence, in the stools, of an acute inflammatory process. They are inclined to support the statement made by Cowan and Miller (1918) that they doubt the existence of pure endamœbic infection to the same extent as they are skeptical of the existence of chronic bacillary dysentery. "It is this factor that seems to us to inject an element of doubt into the otherwise apparently reliable method of cytodiagnosis as employed in the dysenteries."

Haughwout also states that the microscopic diagnosis of the stools of patients exhibiting dysenteric symptoms requires careful interpretation by an experienced worker, but believes that it is more to be relied upon than bacteriologic diagnosis under the methods and technic now available. He bases a diagnosis of endamœbiasis upon the finding of trophozoites of *E. histolytica* containing erythrocytes, or the characteristic quadrinucleated cysts in the stool. The character of the exudate, however, carried much weight. If the cellular elements of the stools are scanty in amount, or the stools have few leucocytes of the polymorphonuclear type or contain cells that show evidence of having undergone proteolytic digestion, he suspects endamœbiasis but suspends judgment until the *E. histolytica* has been identified.

*Method of infection.*—According to Wenyon, from experiments on cats, there can be no doubt that human beings are infected by the ingestion of cysts. While there is some question as to the exact method of escape of the amœbæ from their cysts and their later development, it is evident that invasion of the intestinal wall by the amœbæ takes place rapidly. In the early stages of the infection the amœbæ make their way to the base of the glands of the large intestine. Here they multiply, and through pressure and possibly by the secretion of a toxin, they cause the cellular elements of the glands to degenerate and separate from one another. By this time the mouth of the gland has probably become blocked, and, if the adjacent glands over a small area of surface are all similarly involved, as is usually the case, a slightly raised yellowish nodule is produced. In the meantime, the amœbæ have made their way into the interglandular connective tissue and a certain amount of necrotic material from broken-down cells has collected. In this condition the yellow nodule is really a small amœbic abscess of the mucosa.

Very soon this abscess bursts into the lumen of the intestine, and the contents are discharged, resulting in the formation of a small undermined ulcer. The amœbæ that escape in this manner invade other glands, causing the condition to spread, or they are passed in the feces with a certain amount of blood and mucus, which represents the discharge from the abscess. The infected portions of the intestine may be very limited, so that only a few scattered nodules are formed, or there may be a more or less continuous infection of most of the glands.

After rupture of the original abscess the ulcer so formed becomes gradually larger, the amœbæ multiply in the base of the ulcer, and it extends over a larger area. They break through the muscularis mucosæ, and extend into the submucous tissues, producing, eventually ulcers which may reach an inch or more in diameter. These ulcers, like the small ones originally formed, have undermined edges, and

become filled with mucoid material, débris of cells, and amœbæ. It is probable that the plugs of mucus and blood which occur in the stools of amœbic dysentery cases represent the discharge from these ulcers. *These masses of mucus may contain enormous numbers of amœbæ.* At any time the amœbæ discharged from the ulcers or glands may infect fresh areas, so that the large intestines of these cases may show every stage in the formation of the ulcers, from the smallest yellow nodules to large undermined ulcers.

Again, according to Wenyon, if the amœbæ are multiplying rapidly in an infected individual and invading one portion of the large intestine after another in rapid succession, the discharge from the ulcers is considerable, and much blood and mucus will appear in the stool, which becomes of the characteristic dysenteric type. If the extension is not rapid, then only occasional plugs of mucus, which may or may not contain blood, are passed, and the individual may be quite unaware of his condition. The cases of rapid extension are regarded as the acute ones, and the amœbæ are all of the large tissue-invading form, many of which contain red blood corpuscles. In other cases where there is not rapid extension, though a considerable area of the wall must be involved owing to the enormous number of amœbæ or their cysts which are passed in the feces, a state known as the " carrier condition " occurs. Exactly what happens in this condition is not properly understood, for it is difficult to obtain perfectly fresh post-mortem material from these cases. It is not possible to reproduce the carrier condition in animals, in which infection either terminates fatally or disappears.

*Prophylaxis.*—The prophylaxis of amœbic dysentery, as with other communicable diseases transmissible by intestinal discharges, simmers down to finger, flies, food, and feces, the chief of which is feces. It is to be remembered, however, that the cysts of *E. histolytica* do not increase outside the human host as do the *Bacillus typhosus*, *Spirillum choleræ*, etc. On the other hand, they are very resistant to high temperatures and more or less resistant to chemical disinfectants, though susceptible to putrefactive changes and desiccation.

In this connection it is to be noted that man contracts his infection through accidental contact with feces containing the cysts and through ingesting the latter or through the eating of food or drinking of water contaminated with cysts, as, for instance, cysts deposited by flies which have visited privies and eaten infected feces. These methods of dissemination emphasize the importance, as other investigators have shown, of adopting such preventive measures of sanitation as will exclude the flies from the feces, and also to safeguard the storage and disposal of the latter.

Wenyon and O'Connor concluded, after finding the cysts of *E. histolytica* in wild flies, that they may play some part in the carriage and dissemination of the cysts. In this connection Stiles observes that each stool containing protozoan cysts which is accessible to flies and to accidental personal contact remains a source of potential danger for several days. It has been found that temperature, moisture, and the rapidity with which putrefaction occurs are the chief factors which determine the length of life of the cysts in the stool. When putrefaction is rapid the cysts remain alive in the feces but a few days. But cysts of *E. histolytica* and other amœbæ have been found apparently viable at the end of a week. They remain alive longer in formed stools than in soft or liquid specimens, as fermentative changes take place more rapidly in the latter. It has been found that when stools containing protozoan cysts are washed to remove their putrefactive products, and contaminating bacteria and distilled water then added, the cysts will remain apparently viable for months; also that the lower the temperature the longer the cysts survived, due to the inhibition of bacterial growth and of consequent putrefaction because of the low temperatures. How long the cysts remain infective after defecation has not been determined, but in view of experimental evidence that they remain viable for a long time, there is danger of their being infective for the same period. It is interesting to note that the cysts of *E. histolytica* appear to be viable as long as five days in 5 per cent formalin.

According to Boeck (1921), the period of longevity of the intestinal protozoan cysts of man is directly related to the period of infectivity of the cysts, and the prophylaxis of protozoan infections. He carried out a series of experiments to determine the length of time protozoan cysts would remain viable after leaving the intestinal tract of the host. In these experiments those cysts were considered to be alive which did not stain in eosin solution and showed but little or no plasmolysis and little or no loss in refractility, while those cysts which stained in eosin solution or remained unstained, but were markedly degenerated, were held to be dead. It has been shown by Kuenen and Swellengrebel, and later by Boeck, that the presence of bacteria and the chemical products of putrefaction exert a deleterious influence upon the vitality of the cysts. To remove or reduce these factors the stools known to contain cysts in sufficient numbers were washed according to the following technique.

The stool was immersed in distilled water and comminuted with a mechanical mixer. It was then strained through a couple of layers of bolting cloth which removed the coarse fecal matter. The filtrate was allowed to stand for a few hours, during which time the cysts fell to the bottom of the container. The supernatant fluid containing

bacteria and water-soluble putrefactive products was drawn off and more distilled water added. This procedure was repeated several times until the supernatant fluid was no longer colored or turbid and then the cysts were transferred to a bottle with 50 to 100 cubic centimeters of distilled water, and kept in a cool place where the temperature varied from 12° to 22° C. This low temperature inhibited excessive bacterial growth and retarded putrefaction to the point that it might be considered negligible.

The longevity studies were made upon the cysts which were kept under two different environmental conditions. Under the one, they were kept in their respective bottles, and under the other in vaseline slide preparations. In both instances the temperature, from 12° to 22° C., was the same and they were neither exposed to sunlight nor kept in total darkness.

As a result of these experiments, the cysts of *E. histolytica* were found to be alive at the expiration of 153 days, and in the eosin stained wet preparations mounted on slides and sealed with vaseline at the end of 211 days. While the results of these observations did not reveal the actual length of life of the cysts, they demonstrated that, under the conditions noted, the cysts remained viable for a considerable period of time.

Other investigators have made observations on the longevity of the intestinal protozoan cysts of man, among them, Penfold, Woodcock, and Drew (1916), who kept the cysts of *E. histolytica* alive in running water for 15 days; Thomson and Thomson (1916), who observed viable cysts of *E. histolytica* in moist feces after 16 days; and Wenyon and O'Connor (1917), who observed viable cysts of *E. histolytica* in moist feces after a month; but experiments were not conducted to ascertain if the viable cysts were infectious for man or laboratory animals.

Root (1921) has shown that cysts of the human intestinal protozoa remain apparently viable for many hours in the intestine of the fly. It seems significant to point out that those cysts which survived longest in the fly's intestine were of the same species as those which were found to live the longest in the experiments and observations conducted by Boeck as given above. The period of survival of the cysts in the fly's intestine was proportional to their longevity outside when immersed in distilled water, although the length of life of the cysts in the intestine was ever so much shorter. Root recovered viable cysts of *E. histolytica* after they had remained in the intestine of the fly for 49 hours.

In a series of experiments to determine the thermal death point of protozoan cysts, Boeck (1921) placed viable cysts that had been

washed and kept in distilled water according to the technique employed in his viability observations in test tubes. The test tubes were placed in a water bath after a given temperature had been reached and kept there for five minutes. Precautions were always taken to maintain the proper temperature for the entire five minutes.

In these experiments, with the aid of the eosin test of viability, the thermal death point for *E. histolytica* was determined to be 68° C. Boeck noted that the remarkable resistance of all the protozoan cysts to a high temperature is quite analogous to that of the spores of bacteria. In both instances the thermal death point is much higher than that of their respective vegetative and nonspore bearing stage.

Stiles has summed up prophylaxis in stating that while it is theoretically desirable that all carriers of *E. histolytica* be given proper treatment, it is not feasible, as many carriers will remain undiscovered. When the period of viability of the cysts in the stools is considered, and also a similar period in the fly, which has fed upon feces containing cysts, one is at once impressed with the necessity of instituting such sanitary methods as will destroy or safeguard the human excreta as soon as possible after defecation, and until its final disposal, to prevent the access of flies. Only through proper methods of fecal and sewage disposal to insure against accidental human ingestion of the infective cysts does there seem to be practical hope in establishing prophylactic measures to control the spread of these protozoan infections, both those which are harmless and those which are pathogenic.

Boeck (1922) reported the results obtained from the examination of human excreta collected from 201 privies in a southern city. The examination was made to determine the extent of *Endamœba histolytica* and other intestinal parasitic infections. The privies from which the samples of feces were collected belonged to negro families and were of four types, the concrete vault, can, surface, and L. R. S. The latter type predominated. It consists of a water-tight tank, barrel, or other container to receive and liquefy the excreta; a covered water-tight can, barrel, or other vessel to receive the effluent or outflow; a tight box with a self-closing lid; an antisplashing device; and a ventilating pipe.

The results of these examinations are given in the following table:

*Cases of infection*

| Type of privy | Total number of privies examined | Enda. coli | Endol. nana | Intestinal protozoa: Enda. histolytica | Iodamœba | Chilomastix | Giardia | Cestoda taenia | Unidentified ova | Nematoda: Ascaris | Trichuris | Diplogaster |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Concrete vault | 6 | ------ | 2 | 1 | 1 | ------ | ------ | ------ | ------ | 1 | 1 | 1 |
| Commercial can | 62 | 5 | 6 | 3 | 3 | ------ | 7 | 1 | 3 | 3 | 4 | 5 |
| Surface | 43 | 4 | 10 | 2 | 7 | 1 | 4 | ------ | 4 | 2 | 1 | 6 |
| L. R. S. | 90 | 9 | 13 | 4 | 2 | ------ | 11 | ------ | 30 | 1 | ------ | 40 |
| Total | 201 | 18 | 31 | 10 | 13 | 1 | 22 | 1 | 37 | 7 | 6 | 52 |

The significant result of this study was considered to be that at least 1 out of every 20 privies was a source from which *E. histolytica* might be obtained by carriers, such as flies, for dissemination. Such conditions as these might help to explain the larger number of cases of amœbic dysentery in the Southern States as compared to the Northern States, in which there exist generally more efficient methods of excreta disposal.

According to Boeck there is increasing evidence that the wild rat may become infected by eating feces containing the cysts of *E. histolytica*. It is claimed that in this animal the disease does not always develop into acute dysentery with marked ulcerative colitis, but may take on a chronic form with little or no symptomatology. The rat thus probably becomes a "carrier" and passes cysts of the amœbæ in the feces. This evidence has been the result of the work of Lynch, Brug, and Kessel. The question as to whether the rat acts as a reservoir calls for further study. As the cysts of *E. histolytica* were found to be so prevalent and as they may be transported unaffected by flies that feed upon infected feces or by "carrier" rats, there is additional reason for making such privies as are necessary sanitary and fly proof and for providing proper and efficient sewage systems at the earliest possible moment consistent with local conditions.

It would seem to be a comparatively simple procedure to eradicate amœbic dysentery for all time by making a thorough search for all carriers and curing them by appropriate treatment. The work of Stiles, Boeck, and others, however, indicates that this is far from simple owing to the expense involved and to the wide distribution of numbers of symptomless carriers. The situation is further com-

plicated by the "carrier" stage in rats and possibly in other animals. It has been found neither practical nor possible to give treatment on an extensive scale to all carriers in civil life.

In the naval service conditions are different. The human carrier is a potential source of infection and might lead to considerable dissemination of the infection if called upon for field service. The feces of all recruits from the Southern States are examined at naval training stations for hookworm infection, and this examination could be extended to include a search for carriers of *E. histolytica*. When carriers are found, treatment directed toward the elimination of the infection would be indicated, and this would lead to an opportunity to compare the results obtained by treatment with emetin with results by treatment with the comparatively new drug, yatren.

Yatren, under the name "yatren purissimum No. 105," is a combination of iodine with oxyquinoline-sulphuric acid, with 20 per cent sodium bicarbonate, and has the formula $C_9H_6O_4SNI$ with a molecular weight of 351.03. It contains 28 per cent of iodine, which is held integral in the molecule. It is a finely divided canary yellow powder that keeps indefinitely when protected from light and moisture in blue-colored bottles.

At ordinary temperatures it is soluble in 25 parts of water, becoming very soluble upon the addition of bicarbonate of soda. All solutions of yatren give a green color reaction in the presence of iron.

The first application of yatren, then in use in Germany as a general antiseptic, to the treatment of amœbic dysentery was made by Professor Mühlens and Doctor Menk of the Tropical Institute of Hamburg. Their report in 1921 of eight cases of amœbic dysentery treated by yatren is the starting point of all the literature on this subject.

The outstanding properties of yatren are that it has a constant composition, which permits of an exact dosage and that, in spite of its great antiseptic power, it is nontoxic. In contradistinction to emetin, it does not have an accumulative action on the central nervous system nor on the striated or nonstriated muscle fibers. According to Manson-Bahr, it is now generally conceded that emetin injections, although temporarily successful, do not eradicate an amœbic infection from the bowel even when administered in almost toxic doses. The occurrence of emetin-resistant forms has been quite familiar to tropical practitioners since the World War, and it is for this class of patients that yatren was originally introduced by Mühlens and Menk. Manson-Bahr, Travaglino, Eckert, de Langen, and Lichtenstein have given up to 8 grams of yatren per day by mouth without noting any untoward effects. It is not irritating to the gastrointes-

tinal tract, and rectal injections may be retained overnight without inconvenience. Mühlens and Menk have stated that when the dosage of the drug is increased, a transient diarrhea may be produced. This usually ceases in about two or three days without the necessity of stopping the administration of the drug.

In the treatment of amœbic infections, yatren may be given in one of three ways; in pill form containing 0.25 gram, of which two are given twice daily; in cachet form of 0.5 gram, twice daily by mouth; or by enema of 200 cubic centimeters, containing 3 grams to 6 grams of the drug and given daily for from 8 to 14 consecutive days. For parenteral administration, it is used in the form of yatren-casein.

The conclusion reached by Manson-Bahr and Morris (1925) was that yatren is of definite therapeutic value in the treatment of amœbic infections. Their cases, while limited in number, were all typical examples of the disease and the results obtained were apparently permanent. From the patient's point of view, yatren therapy is more pleasant than any other yet evolved, the toxic effect has been almost negligible, and there has been no apparent necessity to restrict the patient's diet unduly. They employed emetin bismuth iodide and its modification, emetin periodide, in cases that resisted treatment by emetin or yatren.

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## ANTICHOLERA VACCINATION OF THE UNITED STATES MARINES AT SHANGHAI, CHINA, WITH NOTES ON LOCAL CONDITIONS

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The purpose of this paper is to present compiled available statistical data which it is believed will be of interest to medical officers, especially those who may find themselves on expeditionary duty in Shanghai or other oriental ports.

It has also been the purpose of the writer to present a broad survey of prevailing sanitary conditions and to give the treatment of cholera as practiced in Shanghai during a recent epidemic.

It may be stated that the local statistics were obtained with great difficulty and that the statistical data regarding the native population are meager and incomplete, which probably accounts for the higher mortality rate reported for the foreign population.

The population of Shanghai is estimated as follows:

| | |
|---|---|
| International Settlement, including floating population | 848,000 |
| French Concession | 165,000 |
| Chinese city and Nantao, including floating population | 800,000 |
| Chapei and Faoshan district, estimated | 200,000 |
| Pootung, including floating population | 150,000 |
| Total | 2,163,000 |

The International Settlement (British) of Shanghai is located in latitude 31° 15′ north and longitude 121° 29′ east and has an elevation of but a few feet above sea level. The area included within the municipal limits is approximately 5,584 acres, or 8⅔ square miles, with a density of population within the settlement of 749 persons per acre. The annual death rate is given as 20.1 per 1,000 for the foreign population and 15.3 per 1,000 for the Chinese.

The number of inhabited houses and the population within and outside the limits of the settlement are reported as follows:

| | Within limits | Outside limits | | Within limits | Outside limits |
|---|---|---|---|---|---|
| Inhabited houses: | | | Population (mean, 1926): | | |
| Foreign | 4,238 | [1] 1,743 | Foreign | 23,100 | 7,465 |
| Chinese | 69,060 | 2,792 | Chinese | 802,700 | |

[1] Houses on which rates are collected.

The communicable diseases reportable to the public health department, Shanghai Municipal Council, are as follows:

Smallpox.
Scarlet fever.
Diphtheria.
Pulmonary tuberculosis.
Leprosy.
Influenza.
Cerebrospinal meningitis.
Chlora.
Typhoid fever.
Paratyphoid fever.
Amœbic dysentery.
Bacillary dysentery.
Malaria.
Rabies.
Anthrax.
Plague.
Typhus fever.
Relapsing fever.
Encephalitis, lethargica.
Beriberi.

The admissions and deaths reported by the isolation hospitals in Shanghai during the year 1926 are as follows:

| | Foreigners | | Chinese | |
|---|---|---|---|---|
| | Admissions | Deaths | Admissions | Deaths |
| Smallpox | 79 | 22 | 104 | 36 |
| Cholera | 48 | 9 | 321 | 40 |
| Choleraic diarrhea | 26 | 6 | 5 | 0 |
| Diphtheria | 67 | 4 | 82 | 11 |
| Tuberculosis | 126 | 39 | 4 | 1 |
| Plague | 0 | 0 | 0 | 0 |
| Measles | 14 | 0 | 14 | 1 |
| Relapsing fever | 0 | 0 | 3 | 0 |
| Beriberi | 0 | 0 | 0 | 0 |
| Leprosy | 0 | 0 | 0 | 0 |
| Typhus fever | 0 | 0 | 3 | 0 |
| Hydrophobia | 1 | 1 | 4 | 3 |
| Cerebrospinal fever | 4 | 3 | 8 | 5 |
| Influenza | 0 | 0 | 3 | 0 |
| Anthrax | 3 | 1 | 1 | 0 |
| Dysentery | 89 | 3 | 81 | 0 |
| Other diseases | 0 | 0 | 182 | 4 |
| Contacts | 3 | 1 | 99 | 0 |
| Total | 460 | 89 | 914 | 101 |

While on board the U. S. S. *Chaumont* en route to China in February, 1927, both officers and men of the Fourth Regiment, United States Marine Corps, were vaccinated against smallpox and given antityphoid inoculations. The number vaccinated and inoculated was almost 100 per cent of the total number in the regiment, as few had been vaccinated within the preceding year.

The regiment made a hurried landing from the U. S. S. *Chaumont* on March 21, 1927, and the men went immediately to widely separated billets located in the International Settlement in Shanghai. Since the arrival of the troops in the billets all water for drinking purposes has been either boiled, chlorinated, or filtered through a high-pressure filter, Berkefeld type, before being used. The water supply for the International Settlement is furnished by the Shanghai waterworks. It is taken from the Whangpoo River. This river is anything but clean, as the city is built up to the water's edge on both banks and numerous ships of all nations, men-of-war, merchant

ships, and numberless small craft lie at anchor on or ply its bosom. After treatment at the water plant and before delivery into the city's water mains for human consumption, the water is chlorinated. The chlorine content of the treated water, as determined from main in the central district, is from 0.02 to 0.03 part of free chlorine per million. Nitrate, nitrite, and bacterial contents fluctuate often, but at all times, unless otherwise cautioned, the Shanghai municipal laboratory considers the water fit for drinking purposes. Owing, however, to the occasional occurrence of local contamination from waterlogged soil, brought about by damage to the water mains during road repairs or from pipes laid at shallow depths and broken because of the heavy traffic in the streets, the city board of health recommends that the water be boiled or filtered through a germproof filter before being used for drinking purposes. The candle of the filter should be cleaned and boiled once a week.

With two exceptions, only the bucket latrine method of sewage disposal has been available. In Shanghai the prevailing methods of sewage disposal are bucket latrines, open latrines, open sewers (ditches), and in the settlements, in addition to these, there are cesspools and a modern sewerage system. The latter does not reach all parts of the settlement, nor does the property owner always take advantage of the opportunity to install modern plumbing in his house. The municipal council, in addition to its underground sewerage system, maintains wagons for the emptying and carrying away of the contents of cesspools. This service is performed once a day, or more often if necessary. The municipal council realizes a large revenue from the sale of night soil. In some instances, however, it has been noted that the contents of cesspools were pumped at night into the street gutters. Not to mention the unpleasant odors in warm weather, conditions such as these become a menace to the public health because of the breeding of flies and mosquitoes and the possibility of the dissemination of communicable diseases, especially by flies. Sanitary orders were published and are kept posted on all bulletin boards. All garbage and rubbish is collected, deposited in a designated place, and removed once a day or oftener. The latrines are policed by "coolies" employed for this purpose and deodorants and disinfectants freely used.

In May, with the oncoming of warm weather, fly and mosquito prevention had to be undertaken. Wherever practicable all standing water was either drained or oiled and open sewers in the vicinity of billets kept oiled. Strict camp cleanliness was observed, the galleys, kitchens, and living quarters were screened, and lime and chloride of lime was freely used as required.

The Public Health Department of the Shanghai Municipal Council carries on an intensive and extensive antifly and antimosquito cam-

paign during the summer months. These pests, especially flies, may be expected in hordes during the extreme hot weather and monsoon period in August. At this time a large green fly, which is frequently found in latrines, is very prevalent. There is a great deal of rain in Shanghai during both the spring and the summer months, with an average annual precipitation of 44.88 inches.

The three venereal diseases, as has been frequently observed, are very prevalent in all parts of China. Entamœbic and bacillary dysenteries are common the year around, and in summer, malaria, the diarrheas, and typhoid fever are prevalent.

For the period March 21 to October 15, 1927, the average strength of the Fourth Regiment, United States Marine Corps, was 1,500. The total admissions were 638, which gives an annual rate of 746.46 per 1,000. Of these admissions, 604, or 706.68 per 1,000, were for disease and 34, or 39.78 per 1,000, for injuries.

The admissions for communicable diseases, together with the annual rate per 1,000 for the period, are given in the following table:

| Communicable disease | Number of admissions | Annual rate per 1,000 | Communicable disease | Number of admissions | Annual rate per 1,000 |
|---|---|---|---|---|---|
| Angina, Vincent's | 2 | 2.34 | Tuberculosis | 3 | 3.51 |
| Bronchitis, acute | 8 | 9.36 | Diarrhea, flagellate | 2 | 2.34 |
| Catarrhal fever | 30 | 35.10 | Dysentery: | | |
| German measles | 11 | 12.87 | Bacillary | 1 | 1.17 |
| Influenza | 3 | 3.51 | Entamœbic | 2 | 2.34 |
| Malaria | 9 | 10.53 | Venereal disease: | | |
| Measles | 8 | 9.36 | Chancroid | 213 | 249.21 |
| Mumps | 66 | 77.22 | Gonococcus | 101 | 118.17 |
| Pneumonia, lobar | 2 | 2.34 | Syphilis | 36 | 42.12 |
| Relapsing fever | 1 | 1.17 | | | |

Measles and mumps were present and common colds were of frequent occurrence among the personnel of the regiment during the spring months. The first case of mumps developed while the regiment was on board the *Chaumont* en route to China. Two cases of lobar pneumonia were treated.

Amœbic dysentery, apparently contracted in Shanghai, developed in two of the men, and two others were operated upon at the Shanghai General Hospital for abscess of the liver. In both of these cases the abscess was attributed to an infection with the *Entamœba histolytica*, as the patients gave a history of a previous attack of diarrhea, but neither had received treatment for amœbic dysentery and all laboratory findings were negative.

During the summer months, especially July and August, cases of acute enteritis, some of which later proved to be bacillary dysentery, were common. According to the chief pathologist of the Public Health Department, Shanghai Municipal Council, the Flexner type of *Bacillus dysenteriæ* is more frequently recovered there from cases

of bacillary dysentery. The Shiga type was more prevalent in 1927 than in previous years, the proportion being Flexner type, 2, to Shiga type, 1. Antidysenteric serum was given to all patients with diarrhea, and emetin to those showing symptoms of flagellate diarrhea and amœbic dysentery. One patient was admitted with relapsing fever. The disease in this case responded rapidly to treatment with neoarsphenamine. Two patients were admitted with symptoms of dementia precox.

Acute appendicitis of the fulminating type has been relatively common. Thirteen patients were operated upon for this condition and two for inguinal hernia during the period from March 21 to October 15, 1927.

Asiatic cholera has been epidemic in certain parts of China, including Shanghai, during the year 1927. It has been prevalent in Shanghai on 14 different occasions during the past 24 years, in 7 of which it reached epidemic proportions. There is no recorded evidence, however, of cyclical periodicity. The term "epidemic" is applied in Shanghai when at least three cases of cholera develop daily over a period of seven days. The disease has been recorded in other parts of China when absent in Shanghai. This disease, which may be expected with the opening of the melon season, occurs in Shanghai as early as June and as late as August. Chinese merchants offer cut melons for sale on the streets where they are exposed to flies and are seldom, if ever, protected against contamination by flies or other insects. In this connection it is of interest to note the experience related by Scott, of the United States Army, at Tientsin, China, in 1924. He stated that they had some early difficulty in keeping lettuce out of the Army compounds, but that they had no difficulty with the very luscious-looking melons that appear in the markets during the month of August. The reason ascribed was that during the previous summer three of the men belonging to one of the companies were taken sick with cholera, and two of them died. It was said that the cause of the infection had been traced to the eating of an "injected melon." It appears that some of the Chinese gardeners inject their melons, while still on the vine and a few days prior to cutting, with one or two syringefuls of a suspension of human feces in water. It is claimed by the gardeners that these injections appear to fatten the melons and render them more "tasty." As one does not know ordinarily whether a given melon is an injected one or not, they are best used for ornamental purposes only.

Cholera is more prevalent among the Chinese population, and is probably transmitted by food or drink infected directly or indirectly by the excreta from a previous case. The preventive measures are: Proper disposal of feces (primitive methods are conducive to the spread of cholera); control of fly breeding; protection of food and

persons from flies and other insects and from vermin; supervision of food and water supply; publicity; education; individual effort; and anticholera inoculations.

The policy of the Public Health Department of the Shanghai Municipal Council is as follows:

(*a*) An intensive publicity and educational campaign.

(*b*) The provision of free anticholera vaccination for Chinese and indigent foreigners.

(*c*) The periodic examination of water supplies from sources outside of the settlement.

During the 1926 epidemic it was found that the Chapei water supply, taken from Soochow Creek, even more filthy than the Whangpoo River, was infected with the *Spirillum choleræ*. In keeping with the above policy, the Shanghai public health authorities administered anticholera vaccine to all members of the local police force, to whom 1,320 sets of the vaccine were issued during the epidemic of 1926.

The British military forces and the United States Marine Corps personnel stationed in Shanghai were given anticholera inoculations during the current season. For the United States forces the inoculation of the Fourth Regiment, with a strength of 1,500 men, was completed on June 29, 1927, and at the same time 190 men of the brigade troops were given their first injection. During the time the inoculations were given to the troops a number of the members of officers' families residing in Shanghai came to the regimental hospital and requested anticholera vaccination.

The vaccine used in this series of inoculations was made in the laboratory of the Public Health Department of Shanghai Municipal Council. In its preparation two strains of the *Spirillum choleræ* were used. One strain, the *Spirillum choleræ* (Jenkins) from the national collection of type cultures, was obtained from the Lister Institute, London, England, on March 9, 1927, and the other was a local strain that had been isolated in 1925.

The microorganisms were cultured on agar for a period of 24 hours, and the growth was then washed off with a saline solution containing 1 per cent of phenol. The bacterial suspension thus obtained was incubated at 37° C. for a period of 24 hours, after which it was counted and diluted so that each cubic centimeter would contain approximately 4,000,000,000 cholera spirilla. The vaccine was then sterilized by heat and its sterility tested by laboratory methods and further tested by administration to convicts in the municipal jail. Serum obtained from the blood of these convicts, taken 10 days after the second and last injection, showed agglutination of cultures of cholera spirilla in dilutions ranging from 1 to 80 to 1 to 2,000. Owing to lack of time, agglutination reactions were not

made with the blood sera from members of the Marine Corps personnel, before or after the inoculations.

Each course of the anticholera vaccination consisted of two injections. The first injection consisted of one-half cubic centimeter and the second dose 1 cubic centimeter of a vaccine that contained approximately 4,000,000,000 killed cholera spirilla in each cubic centimeter. The injections were given at from 7 to 10 day intervals.

The great majority of the men who received the anticholera inoculations showed no reaction whatever, and no serious reactions were encountered in any of the patients. The only symptoms that were observed were those that might be expected to result from such prophylactic procedures, and were in general much less severe than those experienced after antityphoid inoculations. There appeared to be no difference in the effects or the frequency of reactions in the individuals after the first or second dose.

Both officers and men submitted to these inoculations cheerfully, the state of mind being, no doubt, to take advantage of any protection against an attack of cholera. Only four officers failed to report for vaccination, and it could not be said that these officers refused the inoculations, as they stated that they did not want the injections unless they were actually exposed to infection. Many, however, were more or less skeptical as to the protection given. As far as the available statistics show at the present time, cholera vaccination is of distinct value. This has been the judgment of those who have scrutinized Haffkine's immunization experiments, as well as those who have observed more recent Army experiences. Cholera vaccination naturally is of relative value only, just as is the case in typhoid vaccination. Some claim three to six months' immunization and further state, if complete protection is not afforded, the course of the disease is favorably modified. Vaccination certainly should be repeated every cholera season.

The first case of cholera of the current outbreak was reported as having occurred on June 15, 1927, and the epidemic does not appear to have become very widespread. Seven cases have been notified among foreigners, and 79 deaths among Chinese have been reported by the commissioner of public health, Shanghai Municipal Council, up to October 15, 1927.

*Treatment.*—During the 1926 epidemic of cholera at Shanghai the routine treatment given was as follows: Upon admission, if the condition of the patient was not too severe, a bath was given first, following which the temperature (by axilla), pulse, respiration, and blood pressure were taken. Then a hypodermic of one-one hundredth grain of atropin, followed by an intravenous injection of Sir Leonard Roger's hypertonic saline, at about the rectal temperature, was given

each patient. The amount of saline given varied with the individual, but from 2 to 14 pints were given, with an average in each case of 4 pints. In any event, sufficient saline solution was given to produce a firm pulse and blood pressure above 100 millimeters Hg. The following formulas were frequently used for intravenous medication:

Sir Roger's saline solution:

| | |
|---|---|
| Sodium chloride | 120 grains. |
| Calcium chloride | 4 grains. |
| Potassium chloride | 6 grains. |
| Water to 1 pint. | |

Alkaline solution:

| | |
|---|---|
| Sodium chloride | 13 grains. |
| Sodium bicarbonate | 5 ounces, 50 grains. |
| Water to 20 ounces. | |

For drinking purposes a solution of potassium permanganate (1 to 4 grains to a pint of water) was administered and continued until the stools began to form. Mistura bismuthi was given every four hours for vomiting, and morphine was given in a few cases, mostly opium takers, where the pain caused much distress.

It was found that acetone bodies were present in about one-third of the cases, while albumen was present in about one-half, almost from the beginning. A 2 per cent solution of sodium bicarbonate was given to all patients to drink who showed positive acetonuria. It was also found feasible to give the alkaline solution mixed with the potassium permanganate solution in equal parts and 1 pint of the stock alkaline solution, given intravenously, with 3 pints of Roger's saline, to be repeated if further symptoms of acidosis appeared.

As might be expected, with a blood pressure below 70 millimeters Hg the chances of recovery were slight and the diastolic pressure was too low in most cases to be of any value.

## Conclusions

1. The mortality was 12.45 per cent of all cases.
2. The very old, the very young, and pregnant women have least chance of recovery.
3. Over one-half the deaths occurred before the patients had been in the hospital 24 hours, and seven-sixteenths of them before 12 hours had elapsed, thus giving little opportunity for adequate treatment.
4. Sixty-five per cent of all the cases treated came from outside the settlement.
5. Cases occurring in September and October were of a more severe type than those occurring in July and August.
6. That acidosis, and later uremia, usually occurred after the fifth day of the disease and, therefore, that no patient should leave the

hospital until at least 10 days have elapsed after the onset of symptoms.

EDITOR'S NOTE.—A. M. Larsen, Medical Corps, United States Navy, the force medical officer of the Yangtze patrol, reports that the crew of the flagship U. S. S. *Isabel*, were given anticholera vaccination, presumably during the summer of 1927, but the exact time was not stated. The total number on board the ship, 118 members of the crew and 32 others, or a total of 150, were vaccinated. All persons readily acquiesced to vaccination and were anxious to comply for their own protection.

The vaccine used was procured from the United States naval medical supply depot, Canacao, P. I., but the method followed in preparing the vaccine and the number of bacteria per cubic centimeter were not known. Each course consisted of two injections of 1 cubic centimeter each, with an interval of one week between doses. On account of lack of facilities on board the U. S. S. *Isabel*, no agglutination reactions were made with the patients' sera before or after inoculation.

One slight reaction was reported. In this case the patient's temperature reached 100.2° F. and he experienced a feeling of malaise which lasted but two or three hours. No other reactions were noted.

The force medical officer stated that cholera was endemic along the Yangtze River Valley during the spring, summer, and early fall of 1927, but that there were no extensive epidemics during the year. The exact number of cases which occurred among the native population living along the river was either unknown or not obtainable.

The report of the Public Health Department of the Shanghai Municipal Council, giving the number of cases and deaths occurring among the native and foreign population of the city, is as follows:

| | Notifications | | Confirmations | | Deaths | |
|---|---|---|---|---|---|---|
| | 1926 | 1927 | 1926 | 1927 | 1926 | 1927 |
| Foreign: | | | | | | |
| International Settlement | 37 | 10 | 29 | 7 | 7 | 4 |
| French concession | 11 | | 8 | | 1 | |
| Chinese territory | 22 | 5 | 15 | 3 | 5 | 3 |
| No address | 6 | | 5 | | | |
| Total | 76 | 15 | 57 | 10 | 13 | 7 |
| Chinese: | | | | | | |
| International Settlement | 1,165 | 435 | | | [1] 366 | [2] 94 |
| French concession | 231 | 204 | | | [3] 78 | [4] 26 |
| Chinese territory | 1,518 | 644 | | | 281 | 122 |
| No address | 226 | 65 | | | 22 | 10 |
| Total | 3,140 | 1,348 | | | 747 | 252 |

[1] 173 reported without medical certificate.
[2] 18 reported without medical certificate.
[3] 2 reported by French authorities.
[4] 1 reported by French authorities.

Confirmed in municipal laboratory: First, foreign, August 22; Chinese, June 19. Final, foreign, September 24, Chinese, October 30.

Takano, Ohtsubo, and Inouye (1926), in their monograph entitled "Studies of Cholera in Japan," published by the health organization of the League of Nations, state that because Japan has been frequently invaded by cholera, preventive measures have been studied attentively and considerable literature has accumulated, in the Japanese language, upon this subject. During the epidemic of 1902 in Kobe, prophylactic inoculations of cholera were undertaken upon a large scale in that country for the first time.

"Out of a population of 1,778,320 in the Hyogo prefecture, 77,907 persons were inoculated. The vaccine was prepared according to Colle's method and 1 cubic centimeter of it was the dose for one injection. The reactions were very mild. The highest fever was 38° C. and chills or shiverings were rarely observed; some local tenderness developed five to six hours after the injection, but neither swelling nor redness was marked and they disappeared in three days. Very occasionally there were urticarial eruptions. Polyuria was noted, and slight diarrhea on the day following inoculation occurred in 10 per cent of the persons vaccinated. Nausea and vomiting were very rare.

"Of 1,183 cholera cases among those uninoculated, 882 died, a case mortality rate of 74.5 per cent. Of the 43 patients among those who had been inoculated, 17 died, a mortality rate of 39.5 per cent. The immunity conferred was not absolute, but the rate of infection and the case mortality rate were both greatly decreased. Better results might have been obtained by an increase in the dose of the vaccine.

"Since then cholera vaccines have been used at each epidemic. The vaccine is still prepared by Colle's method. The cholera vibrio, grown on an agar medium, is suspended in physiological salt solution and heated at 60° C. for 30 minutes, and diluted so that 1 cubic centimeter contains 2 milligrams of the organism. Two injections of 1 cubic centimeter and 2 cubic centimeters are given at an interval of seven days. The vaccine contains 0.5 per cent of carbolic acid.

"Tsugane (1916) inoculated 412 students in the Okura Commercial School. A certain amount of pain, swelling, and redness followed the injection. There was slight or moderate fever, headache, and general malaise in 45 per cent; 7 per cent of these had a rise of temperature above 39° C., with abdominal pains and diarrhea, and were confined to bed. One of these cases developed serious heart-failure symptoms. Tsugane concluded that, even with sensitized vaccine, a considerable reaction may be produced dependent upon the state of health of the subject.

"Igarashi and Tanaka (1917) injected with sensitized and heated vaccines, respectively, 51 persons employed, and living under the same conditions, in the Komagome Isolation Hospital, and the agglutinins and bacteriolysins in the serum of these persons were tested.

The first group of 27 persons each received two doses of 1 cubic centimeter and 2 cubic centimeters of the heated vaccine containing 2 milligrams of the organism in each cubic centimeter at an interval of seven days. The second group of eight persons received three doses of the heated vaccine, containing 1.5 milligrams of the organism in each cubic centimeter. They received 0.5 cubic centimeter, 1.5 cubic centimeters and 2 cubic centimeters at intervals of four days and seven days, respectively. The third group of 16 received 1 cubic centimeter and 2 cubic centimeters of the sensitized vaccine, containing 2 milligrams per cubic centimeter, at an interval of four days. The vaccines were supplied by the Government Institute and the Kitasato Institute. The results showed that two weeks after the second injection of the heated vaccine antibodies present in the blood were comparable in amount to that found in recovered cholera patients. Antibody formation in the serum of recovered patients, however, bears no constant relationship to the severity of the illness. Some carriers have as much antibodies in their blood as recovered cholera patients. They also found that sensitized vaccine does not produce antibodies any quicker than does heated vaccine, and the amount produced is also less. In the majority of cases the formation of antibodies reaches its height between the fourteenth and twenty-first day after the injection of the vaccine.

"Yabe (1917) made an observation on 300,000 people who received sensitized vaccine during the cholera epidemic of 1916, and he found that the reactions in all cases were very mild and there were no serious reactions or complications: 80 to 95 per cent had very slight local pain or no reaction at all, and nearly all—certainly more than 98 per cent—were able to continue their work without interruption."

Following the first extensive use of preventive vaccination against cholera at Kobe in 1902, the use of anticholera vaccine has been encouraged in the presence of an epidemic. "The results of the preventive inoculation are difficult to ascertain with any accuracy. It is true that in animal-experiments injection of cholera vaccine confers a certain resistance against infection, and inoculated human beings develop in the body certain evidence of immunity, but it is a question how effective it is in preventing a natural infection. The results of the preventive inoculation in 1902 at Kobe indicated that the infection rate of the inoculated was low, as was the case in the mortality rate of such cases as occurred. It is very difficult, however, to compare the infection rate for those who have and those who have not been vaccinated, respectively. Whether preventive inoculation is carried out or not, an epidemic of cholera in Japan does not last long. As a rule, when preventive inoculation is extensively practiced the epidemic is at its height. Consequently there is a tendency to overestimate the value of preventive inoculation. To obtain

unassailable results, it would be necessary to divide the population of a certain area into two parts, both living under comparable conditions, and submit one group to inoculation, leaving the other uninoculated. Such a procedure is very difficult to carry out in practice.

"Although in Japan preventive inoculation has been practiced for a long time, there are no data that enable one to estimate the amount of protection conferred. Furthermore, the virulence of cholera differs in different epidemics as well as at the beginning and the end of an epidemic. It is generally admitted, however, that vaccination diminishes the risk of infection and the risk of a fatal issue should the disease be contracted.

"In 1916, when sensitized vaccine was first brought into use, Yabe made statistical observations on 300,000 people who had been inoculated with it. The number of persons inoculated in the early part of the epidemic, including those who were exposed occupationally as well as others, was, in Tokyo, 238,936, or 10.64 per cent of the population (2,244,796) and in the suburbs 61,988, or 7.64 per cent of the population (811,150). In the city there were cholera patients among those who had been inoculated (0.13 per 10,000 inoculated persons) and 372 cases among the uninoculated (1.85 per 10,000 uninoculated persons). In the suburbs no case occurred among the inoculated and 229 cases among the uninoculated (3.09 per 10,000). Thus, when the city and suburbs are combined, the rate of contraction among the inoculated is but one twenty-fifth of that among the uninoculated. Murata (1902) stated that the three patients found among the inoculated had not received the complete course of inoculations. The course consisted of two inoculations of 2 milligrams and 4 milligrams, respectively—the patients in question, for one reason or another, had received only one-third to one-fifth of the usual dose.

"In addition to such statistical studies as the foregoing, there are many cases which prove the efficacy of sensitized vaccine. For instance, in a family, the one member who had not received the inoculation contracted the disease, while the others escaped; in a factory, cholera patients appeared only among the uninoculated; no case was reported in a ward in Tokyo where preventive inoculation had been widely practiced, or in another ward, where 29.15 per cent of the population had been inoculated, while among the uninoculated, 18 cases were reported. Such cases afford the best direct evidence of the value of cholera vaccination.

"Sukegawa's report on the results obtained by preventive inoculation with sensitized vaccine in Kanagawa in 1916 is testimony to the efficacy of the procedure. There was no case of cholera among inoculated persons living on boats and in slum districts, but there were several cases of cholera among those who were uninoculated.

"In spite of the fact that the inoculation on this occasion was carried out extensively among those who were most exposed to infection, the majority of the cases were found among the uninoculated—the case mortality rate among the uninoculated was 74.11 per cent, while among the inoculated who contracted the disease five days or more after inoculation it was 35.71 per cent.

"According to observations made in Osaka by Normura, Sotoma, and Harata at the time of the epidemic of 1920, 816,343 persons were inoculated between June 14 and October 30, and of these 559,026 persons received the second inoculation. Thus 66 per cent of the entire population of Osaka was inoculated and 45 per cent received two injections. The number of cases and deaths that occurred and the death rates were as follows:

| | Number uninoculated | One inoculation | Two inoculations |
|---|---|---|---|
| Number of persons | 436, 208 | 231, 541 | 380, 307 |
| Number of patients | 340 | 28 | 11 |
| Per 100,000 population | 77.73 | 12.09 | 2.89 |
| Deaths | 44 | 11 | 2 |
| Per 100,000 population | 33.25 | 4.73 | 0.52 |
| Deaths per 100 patients | 42.38 | 39.28 | 18.18 |

"Shikata (1919) carried out preventive inoculations on 7,443 soldiers in the Seventh Division. He mentioned as reactions following inoculation perspiration and cutaneous eruptions. Nomura and Nagashima reported the rates of contraction and carrier rate to be lower among the inoculated than among the uninoculated. Yasutomi (1921) reported that about the same degree of immunity may be conferred by inoculation with a sensitized vaccine as by an attack of the disease and that this immunity lasts more than six months. According to Sakai, the agglutinin reaction of carriers is increased by vaccination in some cases, while in others the influence is only slight. Mizoguchi stated that when an epidemic of cholera necessitates the vaccination of tuberculous patients, normal doses may be given in mild cases, but in severe cases the first dose should be reduced, and subsequent doses be determined by the severity of the reaction following the first inoculation."

Takano, Ohtsuba, and Inouye state that when the cholera vibrio is introduced into Japan it appears to be influenced by the climate and soil and loses its virulence so that it no longer is capable of causing an epidemic the following year. The existence of winter cholera in Japan indicates that the cholera vibrio is able to survive the winter, but it is very rare that the microorganism becomes the source of another epidemic after surviving the coldest weather of February.

The fatality rate of cholera ordinarily is from 60 to 70 per cent, and sometimes even greater, but in Japan, according to the above authors, there have been rates as low as 50 to 60 per cent and in a few instances even below 50 per cent. The rate appears to be greatest when the disease is newly imported. The fatality rate is rather low in a year in which there are but a few sporadic cases following an epidemic.

They also state that cholera patients and carriers not only spread the disease on land and in ports but they pollute the sea water as well, and that it has been experimentally proved that the cholera vibrio, when thrown into sea water, will survive for a certain period of time. Nogami (1902) found that the vibrio survived for 3 to 4 days when kept at a temperature of 37° C., in the ice chest for from 9 to 10 days, and in sterilized sea water kept at 37° C. for from 30 to 42 days.

One of the most important measures against cholera in Japan, therefore, is the observation of fishermen, boatmen, and examination of sea fish and shells. The measures taken at the time of an epidemic include the prohibition of the transportation of fish, sanitary improvements of fish markets, preventive inoculation, forbidding the throwing of fecal and vomited material into the sea, the supply of a pure drinking water, and educational measures stressing the danger of eating raw fish and uncooked vegetables.

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## AN OUTBREAK OF MALARIA AMONG THE CIVILIAN POPULATION OF OLONGAPO, P. I.

By J. H. Robbins, Lieutenant Commander, Medical Corps, United States Navy

On February 13, 1927, a native with symptoms of malaria was admitted to the Camilla Simpson Hospital for natives, located in the town of Olongapo, P. I., and one week later four additional patients were admitted with the same disease. This led to an investigation of the situation by the medical officer attached to the United States naval station, which is adjacent to and south of the native town. It was learned that during the dry season of each year a large number of cases of malaria appeared among the natives of this section, together with an occasional case among the naval personnel attached to this station.

The topography of the naval reservation is conducive to the prolific breeding of all varieties of mosquitoes. A large area, most of which is a salt-water marsh, affected by the tide, spreads immediately inland from the station and the native town, while farther to the east the Santa Rita Valley extends inland several miles from this marsh. Along the Santa Rita River, which flows through a very tortuous course along this valley, there are areas of slack water unaffected by the tide and a large number of fresh-water pools.

The naval reservation covers an area of about 64 square miles, the greater part of which is extremely hilly, while the naval station proper, the town of Olongapo, and the barrios of Kalalake, Asinan, Tapinac, Baak Baak, and Santa Rita are situated on low-lying land extending from the bay inland up the Santa Rita Valley. This area is roughly triangular in shape, with its apex on the northeastern side of a resort frequented by naval personnel and popularly known as Gordon's farm, located about 5 miles east of the naval station. The northern side of the reservation is bounded by the Santa Rita River, the eastern side by the foothills of the Zambales Mountains, and the other side by branches of Subig Bay. This area is approximately 2 miles across at its base and 4 or 5 miles long. It is subject to the tides and contains a large amount of marsh in which there are several fish traps.

At Gordon's farm there is an open-air cabaret that is frequented by many of the enlisted personnel from the naval station and from the ships that undergo periodic overhaul and dry-docking at the station. There are about 12 bailarinas, native dancing girls, employed by the managers of this cabaret. They come principally from Manila, P. I., and their residence at this resort is of a temporary nature. Three miles from the naval station proper is another cabaret called Tia Juana, which is similar to the one at Gordon's farm and located on the same road. About the same number of bailarinas are also employed at this place. Both of these cabarets are located on the banks of the Santa Rita River, are more or less surrounded by woods and underbrush, and are near large pools formed in the river bed during the seasons in which there is little or no rainfall.

During the month of February, 1927, 12 patients with malaria were admitted to the Camilla Simpson Hospital, all but one of whom were bailarinas from Gordon's farm. The single exception was a taxicab driver who lived in the town of Olongapo and spent several hours each night at Gordon's farm. Practically all of the bailarinas admitted to the hospital gave a history of previous attacks of malaria and had enlarged spleens extending from one to four fingers' breadth below the costal margin. During the following month, March, 1926, 41 cases of malaria were admitted. Of these, 18

came from the vicinity of Gordon's farm, and the remainder, or 23 cases, from various parts of the naval reservation. In addition to the cases noted above, there were 47 patients with malaria admitted to the hospital during the month of April, 19 in May, and 21 in June. The records at the hospital do not show the number of cases of malaria admitted during previous years.

The number of cases occurring in the different barrios, by months, is as follows:

| | February | March | April | May | June | Total |
|---|---|---|---|---|---|---|
| Gordon's farm | 6 | 17 | 6 | 1 | 2 | 32 |
| Santa Rita Road | 2 | 2 | | 2 | 2 | 8 |
| Baak Baak | | | 1 | | 2 | 3 |
| Tapinac | | 3 | 3 | 1 | 1 | 8 |
| Asinan | | 1 | 3 | 2 | | 6 |
| Kalalake | 1 | 3 | 6 | 5 | 2 | 17 |
| Cababai | | 4 | | | 1 | 5 |
| Olongapo | 2 | 11 | 22 | 17 | 6 | 58 |
| Outside | | | 6 | 2 | 1 | 9 |
| | 11 | 41 | 47 | 30 | 17 | 146 |

Blood smears were made in all of the 146 cases noted in the above table and the parasite of benign tertian malaria, the *Plasmodium vivax*, was found in 115 cases; the malignant tertian, or *P. falciparum*, in 17 cases; and the quartan, or *P. malariæ*, in 1 case. Repeated blood smears were negative in 13 cases, but this was attributed to the use of quinine by the patients at their homes prior to admission to the hospital.

There were 140 original admissions for malaria to the Camilla Simpson Hospital from the total of 146 cases recorded in the above table. No case of black-water fever developed among these patients and it is understood that this disease is, apparently, of very rare occurrence among the people of the Philippine Islands. There were no deaths in this group of patients resulting directly from malaria, but one death ascribed to anemia occurred in the case of a patient who had been under treatment at the hospital for malaria, and who was later readmitted under the diagnosis of anemia.

On May 2, 1927, the first case of malaria appeared among the naval personnel attached to the station, and this was followed by the second and last case during the outbreak on May 15, 1927. The records of the station dispensary show the admissions for the past three years as follows: 1924, 0; 1925, 9; and 1926, 5.

The enlisted personnel of the V. T. 20 Squadron, Asiatic Fleet, were quartered in some old buildings in the southwestern end of the naval station. These men slept without mosquito nets from about November 15, 1926, until January 13, 1927, and no case of malaria developed among them.

On December 17, 1926, the submarine U. S. S. *S-38* arrived at Olongapo and the crew were quartered in barracks near those occu-

pied by the men of the V. T. 20 Squadron. On January 14, 1927, the U. S. S. *Canopus* and Submarine Division 17 arrived and were moored alongside the dock used by the Manila ferry, U. S. S. *General Alava*, at the extreme southwestern end of the navy yard. The men comprising the crew of the various submarines of Division 17 were quartered in buildings adjacent to this dock, and all were required to sleep under bed nets. The crew of the submarine U. S. S. *S-38*, which up to this time had not used mosquito bed nets, were now required to do so. Inspections were made every night by the master at arms to see that all the men occupying the barracks were using the nets. The crew of the *Canopus*, however, slept aboard ship and were not furnished with nets.

The outbreak of malaria that occurred among the men of the U. S. S. *Canopus* and Submarine Division 17 was reported in the UNITED STATES NAVAL MEDICAL BULLETIN, October, 1927. The following is quoted from the report made by the medical officer of the *Canopus* on April 22, 1927:

"Malaria appeared first on February 20, 1927, the first case occurring in a radioman on the U. S. S. *S-36* and was of the benign tertian type. Seven cases occurred between this time and the 19th of March, 1927, when the infection assumed epidemic proportions and continued as such until April 6, 1927, when the last case occurred The U. S. S. *Canopus* and Submarine Division 17 left Olongapo, P. I., on March 30, 1927, and arrived at Manila the same date. In the period between February 20, 1927, and April 6, 1927, 48 cases of malaria occurred, one of which was a readmission for recurrence, 34 were malignant tertian type, and the remaining 14 were of the benign tertian type. Those showing benign tertian parasites in their blood invariably had a frank chill followed by a hot stage and sweating. Those showing the malignant tertian parasites complained of a chilly sensation but not a frank chill. Nausea, epigastric distress, vomiting, and headache were the usual subjective symptoms in the malignant tertian cases. Seven cases developed pulmonary symptoms with pain in the chest, usually substernal, expectoration, and rapid respiration. Every case with pulmonary symptoms showed some slight dullness to percussion, usually at the base of the lungs posteriorly, most often on the right side. The response to quinine therapy was prompt in the benign tertian cases, but tardy in the malignant tertian cases, particularly in those having pulmonary symptoms. Because of the pernicious nausea and vomiting in three of the cases, quinine was administered intravenously with good results. There were no deaths during the epidemic, but those cases showing pulmonary symptoms were extremely ill."

Less than 1 per cent of all the native patients admitted to the Camilla Simpson Hospital had a definite chill and but very few com-

plained of chilly sensations. The symptoms experienced by practically all the patients were very similar and consisted of fever, frontal headache, and general muscular weakness, while nausea and vomiting were experienced, in addition, by a few.

The treatment given these patients consisted of calomel in divided doses, followed with Epsom salts immediately upon admission, together with ice packs and cold baths, when necessary, to reduce the temperature. Ice caps were also applied to relieve the headache which was frequently present. Smears were made from the blood of all patients showing symptoms and, when the parasites of malaria were identified, quinine, in capsule form, was given by mouth in the dosage of 20 grains a day, 5 grains in the morning, 5 grains at noon, and 10 grains at night. The same treatment was given to all patients showing symptoms of malaria, even if repeated examinations of their blood failed to show the presence of the parasites. In the event that vomiting was present or the amount of quinine given did not reduce the temperature to normal within three days, 10 to 15 grains of quinine chlorhydrosulphate were given intravenously dissolved in 15 cubic centimeters of sterile water. This was required, however, in but five of the cases admitted, the dose of 20 grains a day by mouth usually reducing the temperature rapidly after the initial rise. There was but one reaction that could be attributed to the use of quinine by the intravenous method. In this case the patient's respiration ceased after 7.5 cubic centimeters, or about one-half the total amount, had been injected. Artificial respiration was started immediately and continued for a period of about 20 minutes, during which time the patient was perfectly conscious, with a pulse rate that varied from 70 to 90 per minute. Needless to say, no more quinine was given to this patient by the intravenous method. His temperature returned to normal three hours after the injection and continued normal under the oral administration of the drug.

On March 16, 1927, when it became evident that an extensive outbreak of malaria was developing in the vicinity of Olongapo, the Philippine Public Health Service was requested to send a representative to advise the medical officer of the naval station in regard to the measures required to prevent the further spread and to control the outbreak of malaria then present.

Representatives from this service arrived at Olongapo on March 19, and, with the assistance of a member of the Naval Hospital Corps, made blood smears from many persons residing in the various districts of the reservation. A preliminary report, based on the results of a study of about one-fourth the total number of blood smears taken, showed that about 30 per cent of the total number of persons examined had a malarial infection.

On March 22, 1927, the medical officer requested that additional representatives of the Philippine Public Health Service be sent to start the necessary malaria-control work in the vicinity of Olongapo, and they arrived six days later. Up to the present time these men, including a sanitary engineer from the Rockefeller Foundation, have discovered that practically all the marsh lands surrounding the navy yard proper are infested with large numbers of anopheles mosquitoes. Dippings from these areas showed that larvæ, both anopheline and culicine, were present in numbers varying from one or two to as high as several hundred to each dip. As this marsh has many crab holes which contain water at low tide, it is no difficult feat to dip larvæ from any place when the marsh is covered by the incoming tide. This probably explains the extremely wide area of infestation. The larvæ found were as follows:

1. *A. ludlowii*—marshy area.
2. *A. subpictus*—marshy and fresh-water area.
3. *A. bancrofti*
4. *A. fuliginosus* } Seepage area near foot of hills at Tapinac.
5. *A. pallidus*
6. *A. minimus*—streams and upper part of river, also near water dam.
7. *A. aitkeni*—Gordon's farm, main river.

Mosquitoes caught in houses located in the station proper and in the town of Olongapo, and also at Gordon's farm, were identified as *Anopheles minimus*, *Anopheles rossi*, and *Anopheles ludlowii.*

With the help of the sanitary engineer from the Rockefeller Foundation at Manila and in conjunction with the Philippine Public Health Service, measures were taken to eliminate the breeding of anopheles mosquitoes. Inasmuch as the Paris green mixtures only kill the surface-feeding larvæ of the anopheles mosquitoes, many of which are efficient vectors of malaria, and have no effect upon larvæ that feed beneath the surface, such as the dengue carrying *Aedes*, it was the medical officer's intention to try to prevent the breeding of all mosquitoes. If this were successful, it would appear to be a comparatively simple matter to keep a check on the entire reservation, and in case mosquitoes were subsequently found their breeding places could probably be located with less delay and further breeding prevented. Otherwise the check on anopheles mosquitoes could be carried out either by the appearance of new cases of malaria or through the services of a trained worker capable of recognizing the different species of mosquitoes and larvæ taken while making continuous inspections of their breeding places. With this in mind, methods of control were devised to eliminate, if possible, all mosquito breeding within the area treated.

During March and April, 1927, the mosquito producing areas were treated with material distributed by airplane as follows:

| Date | Time | Material used |
|---|---|---|
| Mar. 31, 1927 | a. m. | 4 cans of dust containing 2 per cent Paris green (75 pounds each). |
| Apr. 1, 1927 | a. m. | 3 cans Paris green. |
| Do. | p. m. | 2 cans water containing 2 per cent Paris green (45 pounds each). |
| Apr. 2, 1927 | a. m. | 3 cans water, 5 per cent Paris green. |
| Apr. 3, 1927 | p. m. | 2 cans shavings, 10 per cent Paris green. |
| Do. | p. m. | 2 cans dust, 10 per cent Paris green. |

In the last two experiments kerosene was used with the shavings and dust.

On April 3, 1927, about 300 pounds of road dust containing 5 per cent of Paris green was sprinkled on the surface of the water at the entrance to the fish traps when the tide was coming in, with the hope that the tide would carry the mixture over the entire area occupied by the traps.

On April 13, the contents of eight barrels containing approximately 500 pounds of sawdust impregnated with crude oil was scattered with the aid of the Boy Scouts over an area of approximately 90,000 square feet at low tide. An inspection 24 hours later revealed no trace of the sawdust-crude oil mixture, it having been carried away by the outgoing tide.

On April 24, thirteen 1-quart cans, equipped with one or two wicks each, and filled with crude oil, cut by means of gasoline, were placed in two fish traps as a further experiment. The following day 5 and 10 gallon cans with from one to three wick drains each were placed at the entrances to numerous fish traps, and at the same time about twenty-five 1-quart cans were placed in an area where there were many pools of stagnant water containing larvæ.

A daily watch was kept on the oiled areas and active larvæ were found 96 hours later even where a thick layer of oil was still present. In the fish traps it was found that a surface growth of moss interfered with the proper filming of the oil.

On April 26, experiments were carried out in one fish trap of approximately 500 square feet. Small pans containing active mosquito larvæ were placed in various locations about the trap and dust containing 1 per cent of Paris green was thrown into the air by hand in such a manner that it would be carried over the trap by the wind. One hour later it was found that a mortality varying from 75 per cent, in the pans which had been placed nearest the source of the dust, to 10 per cent, in the pans farther away, had occurred among the larvæ.

Two weeks later 25 laborers, placed under the direction of a representative of the Philippine Public Health Service and a trained Hospital Corps man, dusted the entire mosquito-producing area. At

the same time the owners of the various fish traps were given instructions in the methods to be used in applying the dust to their individual traps. For this purpose a 10 per cent mixture of Paris green in dust was used. Repeated dippings following this treatment failed to show any trace of anopheles larvæ in the sections treated.

It was contemplated to keep from three to six laborers constantly at work the entire year under the supervision of a trained worker, unless this should prove to be impracticable during the rainy season, but on account of extremely heavy rains all control work was stopped about May 15, 1927. Owing to the lack of funds nothing further has been done in mosquito-control work, despite the repeated recommendations of the medical officer. Since the advent of the rainy season and the cessation of all antimosquito work a large increase in the numbers of anopheles mosquitoes has been noted in the navy yard proper, and cases of malaria have occurred occasionally among the native population, which continues to be the reservoir of malaria.

Editor's note.—The report of the Philippine Health Service for the year 1920 states that malaria is one of the most important causes of morbidity and death in the islands, with an incidence of 301.9 per 100,000 of population and a ratio of 14.3 per cent of the total deaths.

Tiedeman (1926), working under the auspices of the Government of the Philippine Islands and the International Health Board of the Rockefeller Foundation, carried out a series of observations on the island of Luzon in the Provinces of Laguna, Bataan, and Pampanga during the period from March, 1922, to November, 1924, and found that, in these Provinces, malaria occurs in moderation and is generally more prevalent in the vicinity of the rivers, in the foothills, and along the borders of uncultivated lands. He found seasonal variations in the occurrence of malaria, attributable to the dry seasons, during which time the river breeding types such as *Anopheles ludlowii* and *Anopheles minimus* predominate.

Of 6,343 blood smears examined, 17.8 per cent contained some form of the parasite. Of these positive smears, 72.5 per cent showed tertian forms, 16 per cent showed quartan forms, 10.5 per cent aestivo-autumnal forms, and 1 per cent mixed forms. In support of Carter's statement that malaria and prosperity do not at any time coexist, Tiedeman found that 71 per cent of the individuals present at the labor barrio of Tucop during nine months of the year 1923 had attacks of malaria at some time within that period, with corresponding loss of pay.

A total of 11 species of anopheline mosquitoes was found in the sections of Laguna and Pampanga Provinces in which studies were made. These species are listed, together with synonymous names for them, places found, and efficiency as a carrier of malaria, in the following table:

| Philippine Anopheles and synonomy | Place found | Breeding places of larvæ | Efficiency as malaria carrier |
|---|---|---|---|
| . (Anopheles) aitkenii (James).<br>fragilis (Theobald).<br>pallidus (Ludlow).<br>treacherii (Leicester). | Olongapo. | Large grassy pools or ponds and among vegetation in ditches and streams. | No data. |
| A. (Anopheles) gigas (Giles). var. formosus (Ludlow). | | Same as aitkenii. | |
| A. (Anopheles) bancrofti (Giles).<br>pseudobarbirostris (Ludlow).<br>pallidus (Swellengrebel and Swellengrebel, 1919).<br>barbumbrosus (Strickland and Choudhury, 1927). | In large numbers at all seasons. | Same as aitkenii. | 4 per cent positive. |
| A. (Myzomyia) minimus (Theobald, 1901).<br>christophersi (Theobald, 1910).<br>formosaensis (I. Tsuzuky, 1902).<br>cohaesa (Donitz, 1901).<br>mangyana (Banks, 1906).<br>alboapicalis (Theobald, 1910).<br>flavirostris (Ludlow, 1913).<br>febrifer (Banks, 1914).<br>merak (Mangkoewinoto, 1919). | Showed a marked seasonal prevalence; found in undeveloped sections. | Edges of clear running streams; frequently among aquatic growths; also along roots of trees and rocks at edges of streams where there is no vegetation. | Efficient. |
| A. (Myzomyia) subpictus (Grassi, 1902).<br>rossi (Giles).<br>error (Theobald. 1903). | In large numbers at all seasons. | In large numbers in temporary collections of water in carabao's hoofprints, in water containers, pools and ponds, among weeds, and in muddy streams. | 11 per cent positive. |
| A. (Myzomyia) ludlowii (Theobald, 1903).<br>flavescens (Swellengrebel, 1921).<br>hatorii (Koidzumi).<br>indefinata (Ludlow, 1904). | In Pampanga but not in Laguna Province; showed a marked seasonal prevalence; found in undeveloped sections. | Edges of clear running streams; frequently among aquatic growths; also long roots of trees and rocks at edges of streams where there is no vegetation. | Efficient. |
| A. (Myzomyia) parangensis (Ludlow). | | | |
| A. (Myzomyia) fuliginosus (Giles, 1900).<br>leucopus (Donitz, 1901).<br>jamesii (Liston, 1901).<br>nogpori (James and Liston, 1904).<br>adiei (James and Liston, 1904).<br>lineata (Ludlow, 1909).<br>mcgregori (Banks, 1909). | In large numbers at all seasons. | Same as aitkenii, but more frequently in streams or larger ponds. | 5 per cent positive. |
| A (Myzomyia) pallidus (Theobald, 1901).<br>philippensis (Ludlow, 1902).<br>nivipes (Theobald, 1903).<br>freerae (Banks, 1906). | In large numbers at all seasons. | Same as aitkenii, but more frequently in streams or larger ponds. | No data. |
| A. (Myzomyia) kochi (Donitz, 1901).<br>ocellatus (Theobald, 1901).<br>flava (Ludlow, 1908).<br>halli (James, 1910). | In Laguna, but not in Pampanga Province. | Pools; occasionally found in sluggishly flowing ditches. | 13 per cent positive. |
| A. (Myzomyia) tesselatus (Theobald, 1901).<br>deceptor (Donitz, 1902).<br>thorntonii (Ludlow, 1904).<br>ceylonica (Newstead and Carter, 1910). | Found infrequently and in small quantities. | No data. | No data. |

The above findings were based upon the identification of more than 9,000 anopheline mosquitoes bred from the larvæ and more than 2,000 caught wild. Based upon the observation that, in some places, the incidence of malaria was high, particularly during the time that *A. minimum* and *A. ludlowii* were numerous, it was concluded that these two species are the important carriers in that part of the Philippine Islands. The rice-field types, such as *A. sinensis*, are mostly harmless. No tree-hole breeders were found.

One of the first methods of mosquito control studied was the possible use of fish. There are no minnows to be found in the islands. The top minnow, *Gambusia affinis*, used extensively for the destruction of mosquito larvæ in the southern part of the United States, was introduced into the Philippine Islands from Hawaii by Seal and placed in many esteros in and about Manila and also in many pools and artificial ponds. Later none of these minnows could be found and it was the opinion that the native fish known as "dalag" was responsible for killing them off, although the salinity of the water may have been a factor. Unlike the natural enemies of *Gambusia* in the United States, this fish will go into very shallow water, and has even been known to follow a muddy furrow across a field. The *Gambusia* are fast swimmers, and it has been demonstrated by Herre that it is possible to keep them in a tank with other fish when a coarse screen is placed across one corner of the tank to provide a haven for them in time of pursuit, so it may be possible to protect them from their enemies by building refuges in the bodies of water in which they are placed.

It was noted that the appearance in large numbers of the young of some species of fish seemed to control mosquito breeding in the streams temporarily toward the end of the dry season. The only fish, however, that seemed to hold much promise in mosquito control was *Dermogenys viviparous*, Peters. This fish is a so-called "half beak," a surface feeder, and does not grow very large. But upon examining a large number of natural bodies of water, though *Dermogenys viviparous* was always found, yet in spite of its rapid producing powers, it never occurred in large enough numbers to accomplish mosquito control. Probably natural enemies among the larger fish prevent them from becoming numerous.

Oil was found to be of little value, as most of the breeding occurred in running water, where oil is least effective. It has a tendency to follow the currents and miss the quiet places around the weeds to which the larvæ frequently retreat. Paris green, 1 part by weight mixed with 100 parts of road dust and passed through a 50-mesh screen, proved very effective when distributed by means of a machine duster, such as the Champion dusters, but it was found that dusting with this mixture by hand was both difficult and wasteful of material.

It was only necessary to apply it along the edges of the streams or in places where the water weeds were thick. It was quite effective, even among water weeds where oil was found to have practically no effect. Obviously it was necessary to treat all breeding places at frequent intervals with the dust-Paris green mixture to secure the best results. It was found that breeding areas had to be treated at least once every week, as the very minute larvæ were not killed.

Griffitts (1926) treated a brackish pool teeming with the larvæ of *A. tæniorhynchus* and *A. sollicitans* with an indefinite but strong mixture of Paris green and wet sand with the result that all the larvæ were killed within 24 hours. It was noted that the wet sand carried the Paris green to the bottom, the greenish-colored sand showing quite distinctly on the sandy bottom of the pool, with a very definite amount of sand and Paris green remaining on the surface of the water.

Following this, further experiments were made with Paris green rubbed up or mixed with moist sand in the proportions generally used in dusting collections of water for the destruction of anopheline larvæ. After mixing sand and Paris green, in the proportion of 1 part of Paris green to 99 parts of moist sand, a microscopic examination of the grains of sand showed that a large percentage of the grains had particles of Paris green adhering to them. When some of this mixture was recovered from the bottoms of containers and pools, particles of Paris green were found to be still adhering to the grains of sand.

In all of the experiments with water containing larvæ of *Anopheles crucians* and *Ædes ægypti* the ædes larvæ were killed and sufficient Paris green was left on the surface, either free or adhering to small floating particles of sand, to kill the anopheles larvæ as well. Further experiments made with water holding larvæ of *Culex salinarius*, *C. quinquefasciatus*, *Ædes tæniorhynchus*, *A. sollicitans*, *A. ægypti*, and *Anopheles crucians*, showed a mortality among the larvæ of 98 to 100 per cent within 1 to 16 hours after the application of the sand-Paris green mixture. Generally, the production of salt-marsh mosquitoes takes place in relatively shallow water, and for these species this method is particularly effective.

From these obseravtions it was concluded that the toxicity of the Paris green applied by the wet-sand method continues for a longer period, especially when used in artificial containers in the laboratory, than has been reported for Paris green when applied with dust to the surface in antianopheles work. Paris green is apparently lethal to subsurface-feeding mosquito larvæ as well as surface-feeding larvæ, and moist sand is not only an efficient sinker for Paris green but also takes it up and retains it in contact with the individual grains.

### THE RELATION OF PARATYPHOID BACILLI TO FOOD POISONING

The article which follows is by Dr. E. O. Jordan, of the University of Chicago, Chicago, Ill., and was read by him at the fifty-sixth annual meeting of the American Public Health Association, at Cincinnati, Ohio, October 17, 1927. It is reprinted from the December, 1927, number of the American Journal of Public Health, for the information of the service:

Paratyphoid bacilli are associated with a train of symptoms of a kind popularly deemed to be highly characteristic of food poisoning—nausea, abdominal pains, and diarrhea—following a few hours after the meal at which the incriminated food was eaten. These bacilli were the first, as they are still perhaps the best known, to have their specific relationship to food poisoning clearly demonstrated. There remain, however, as will appear, unsolved problems connected with the part they play in the production of human illness.

One of the earliest sources of difficulty was the confusion that long existed with respect to the different species or varieties. Paratyphoid bacilli, or, as some writers prefer to call them, bacilli of the Salmonella group, are now known to comprise a number of organisms more or less culturally and immunologically distinct and of diverse epidemiological significance. Bergey's Manual lists 19 "species" under the genus Salmonella, and Ford describes 17 bacteria of "the paratyphoid group." Both authors, however, designate by different names organisms that are certainly identical. The nomenclature of the group is in need of thorough revision.

At least one distinction of great practical importance is now generally recognized. Certain of the paratyphoid bacilli—notably the types known as *B. paratyphosus A*, also called simply *B. paratyphosus*, and *B. paratyphosus B* of the Schottmüller type, or simply *B. schottmulleri*—are primarily bacilli of human infections and pass from an infected human being to a healthy one in precisely the same way that *B. typhosus* does. *B. paratyphosus* indeed appears strictly limited to the human host, never having been found, so far as I am aware, in infections of the domestic animals or in house vermin. *B. schottmulleri* also can commonly be traced to an infected human being, but seems occasionally to be found in swine; no epidemiological connection of *B. schottmulleri* of porcine origin with human disease, however, has ever been demonstrated.

Other known paratyphoid bacilli appear to be parasites of various mammals and birds and, in some instances, as in the organism of contagious abortion in mares, are quite definitely spcialized to a particular host. Others, such as *B. enteritidis*, are more cosmopolitan; this organism has been found in spontaneous laboratory outbreaks among guinea pigs, mice, and white rats and also in diseased swine and in cattle.

### Confusion in Nomenclature

Part of the confusion with respect to the identification and classification of the members of this group has been due to mistakes in nomenclature, part to the assumption that the nature of the organism could be determined by its origin—e. g., that all cultures from mice were of the "typhi murium" variety—and part to inadequate differential methods. Names given to individual members of the group have been loosely applied to the whole group; the terms Gärtner bacilli and hog cholera bacilli have been sometimes used in one sense, sometimes in another, so that it may be impossible, for instance, if an investigator has reported finding "Gärtner bacilli" in a food-poisoning case, to know whether he really found *B. enteritidis* or simply some organism with the general paratyphoid bacillus characteristics. It does not follow, moreover, that the isolation of a paratyphoid bacillus from diseased swine or from pork that has caused food poisoning is prima facie evidence that the bacillus is of the type known as the "hog cholera" bacillus; at least four distinct varieties of paratyphoid bacilli have been isolated from swine. These two sources of error were difficult to control until adequate methods of differentiation were developed.

In Germany *B. suipestifer* and *B. schottmulleri* were for a long time believed to be identical, and this belief resulted in considerable confusion as to the relation between human and animal infections. In England several observers recognized that some difference existed between the human paratyphoid bacilli and what they called *B. suipestifer*, but wrongly identified *B. suipestifer* with *B. aertrycke*, the common food-poisoning bacillus of this group. Thanks to the work of Schutze, Savage, and White in England and of Krumwiede, Koser, and others in this country, much more is now known about the various members of the group and their relations to one another and to the epidemiology of food poisoning.

### Classification

The general picture is now quite clear. Two species, *B. paratyphosus* and *B. schottmulleri*, are primarily human parasites, and no infection with these organisms has yet been traced to a preexisting infection in the lower animals. Among the remaining species, the "animal paratyphoids," several different kinds have been shown by fairly conclusive evidence to be the occasional cause of outbreaks of food poisoning; others are under suspicion.

1. *B. enteritidis*.—This organism was the first to be definitely connected with an outbreak of food poisoning. It was discovered by Gärtner in 1888 in a meat-poisoning epidemic in Germany, and the evidence brought forward as to its causal relation was quite con-

vincing. Since that time this bacillus has been reported in a number of similar outbreaks in various parts of the world. While it is necessary to discount reported findings of Gärtner bacilli that lack further description of the organisms, there are on record a considerable number of outbreaks due to fully identified strains of *B. enteritidis*. In my collection of well-authenticated food-poisoning bacteria there are three strains of this organism.

More needs to be known about the previous sources of infection with *B. enteritidis*. There is some reason, however, for connecting this organism with bovine infections; the original strain isolated by Gärtner was derived from a cow ailing before slaughter and in other outbreaks beef, veal, and milk seem to have been rather commonly implicated. There are other possible sources. Savage and Forbes (1) attribute an outbreak in England to contamination of food by a food handler, but the evidence on which they rely is not conclusive. Another and more probable source is contamination of food by rodents. *B. enteritidis* has been found in spontaneous outbreaks among rats and mice, both in the laboratory and under natural conditions. The original Danysz strain was probably of this type. Most of the commercial rat viruses appear to contain this organism, and a *number of human infections with rat viruses have been reported.* (Italics ours.) The question of food contamination by rodents is of practical importance and I shall return to it presently.

2. *B. suipestifer.*—This organism, formerly believed to be the cause of hog cholera, seems to be a pretty definitely specialized parasite of the pig, where it is found, perhaps as an accessory invader, in various diseased conditions. I have never met with this organism among strains from rodent or bovine sources, but apparently it may rarely affect animals other than swine. A bacillus isolated from the mesenteric gland of a monkey was sent me from the Lister Institute and has proved to be typical of this species. Human food poisoning due to *B. suipestifer* has occurred, but seems to be relatively rare. The channels by which *B. suipestifer* finds its way into incriminated food seem to have remained undiscovered, although pig meat has been usually suspected. It is remarkable that despite the frequent occurrence of hog cholera, in which this organism is usually present, there are no reported instances of farm outbreaks of human food poisoning associated with outbreaks of the porcine disease.

3. *B. aetrycke.*—This seems to be preeminently the organism of food poisoning. By far the larger number of paratyphoid cultures isolated from typical food poisoning outbreaks and completely identified by modern methods belong to this type. Ten of the food poisoning strains in my collection are of this species, and Savage and White in their study of 100 recent outbreaks of food poisoning in Great

Britain record a similarly high proportion of *B. aertrycke.* This species closely resembles *B. schottmulleri* in both its cultural and agglutinative characters, but can now be separated from it by cultural tests as well as by the time-consuming method of agglutinin absorption. Much of the difficulty experienced in establishing the true etiology of food poisoning has been due to failure to distinguish *B. aertrycke* from *B. schottmulleri* and *B. suipestifer.* It is probable, for example, that most of the food poisoning outbreaks at one time ascribed by British authors to *B. suipestifer* were really due to *B. aertrycke*, although most of the descriptions do not permit complete identification and the original cultures have long since disappeared. The loose use of the name *B. suipestifer* has misled some writers, as apparently it has recently Damon and Leiter (2), into supposing that *B. suipestifer* is "not infrequently the etiological agent" in food poisoning epidemics; Gill (3), however, to whom these writers refer, expressly uses the designation "Bacillus suipestifer (aertrycke)." The authenticated food poisoning strains that I have received from British sources with either the label "B. suipestifer" or "mutton type" are all *B. aertrycke.*

Like *B. enteritidis*, *B. aertrycke* appears to be sometimes present in food as a contamination from ailing animals. It occurs in diseases of cattle and calves although, so far as can be judged from the meager evidence, not so commonly as *B. enteritidis.* It has been found in several extensive epidemics of sheep, and meat from those animals, when used for human food, has caused illness. The famous "mutton strain" of the Lister Institute is the prototype of this group. *B. aertrycke* does not seem to have been found in swine. Different species of rodents, such as guinea pigs, rabbits, and mice are occasionally infected with *B. aertrycke.*

The history of the outbreaks of food poisoning in which *B. aertrycke* has been found often fails to present satisfactory information as to the source of the specific contamination. In the instances reported by Savage and White, such diverse articles as milk, canned tomatoes, beef brawn, cockles, and canned apricots were suspected as the vehicles of infection. The frequency with which food substances of other than animal origin are concerned lends countenance to the belief that contamination of food by rats and mice may be an important factor. Contamination by human carriers of *B. aertrycke* is a possibility, but remains to be proved.

Whether other "animal paratyphoids" may give rise to food poisoning is not known. A number of outbreaks due to the consumption of horse meat have been reported in European countries, but in no instance does it seem to have been determined that the equine paratyphoid strain (*B. abortivo-equinus*) was the causal organism. A similar uncertainty exists with respect to the share of

the avian paratyphoid strains, *B. sanguinarium* and *B. pullorum*, in causing food poisoning. As yet no evidence of causal connection has been brought forward.

There seems little doubt that the animal paratyphoids causing food poisoning sometimes pass from the alimentary tract into the tissues and cause a true infection. This is true at least of *B. enteritidis* and *B. aertrycke*, both of which have been found not uncommonly in necropsies. It is not clear, however, how far the physiological phenomena of food poisoning are to be charged to the growth of living bacilli in the body and how far to the action of former poisons. It has been shown by a number of investigators that certain paratyphoid bacilli produce a poisonous substance, and that the filtrates of even young cultures are toxic. Animal experiments with the poisonous filtrates have been difficult to interpret since the culture filtrates are toxic for rabbits and mice when injected intravenously, but have no apparent effect when given by other routes. Miss Branham, of the University of Chicago, has shown that the Berkefeld filtrates of 6 to 13 day old *B. enteritidis* cultures in a synthetic medium of ammonium succinate, dipotassium phosphate, and sodium chloride are extremely toxic for rabbits. These filtrates give at most a very faintly positive protein reaction. They have definite antigenic properties and stimulate in rabbits the production of agglutinins, precipitins, complement-fixing antibodies, and possibly antitoxins. The toxic cultures and filtrates of paratyphoid bacilli are thermostabile, and withstand boiling and even autoclaving without loss of toxic power.

### Intoxication or Infection

The short period elapsing in certain partyphoid food poisoning outbreaks between the ingestion of food and the appearance of symptoms has lent color to the belief that poisons already formed in the food or arising from the distintegrated bacterial cells were the cause of illness rather than the growth of the bacilli in the human body. The transient character of the symptoms is in accord with this belief. Some outbreaks give evidence both of immediate toxic action and of infection. Savage and White have attributed a number of food poisoning outbreaks occurring in Great Britain to the action of thermostabile paratyphoid toxins present in foods preserved by heat. The specific epidemiological and laboratory evidence presented by these writers is, however, of varying degrees of cogency.

As matters stand, there is ground for believing that preformed thermostabile toxic substances produced by certain paratyphoid bacilli play a part in the causation of food poisoning. Just how important this is as compared with the part played by living bacilli remains to be determined. The epidemiological resemblance between this type of food poisoning and Asiatic cholera, in which

there occurs a rapid multiplication and subsequent disintegration of the specific microorganisms in the alimentary tract may perhaps be significant.

### Prevention of Paratyphoid Food Poisoning

Prevention of paratyphoid food poisoning may be effected in various ways. The two human types of paratyphoid fever, which in some of their manifestations are closely related to food poisoning, can probably be best combated by avoiding contact with the sick, by guarding food supplies, especially milk, against contamination by carriers or convalescents, and by eliminating polluted drinking water. In a word, the measures found effective against typhoid infection are likely to reduce the human paratyphoid infections in equivalent degree. Protective inoculation against the two paratyphoid fevers has been largely practiced in recent years in the use of the so-called triple vaccine, but I am not aware of any valid statistical evidence that their prevalence has been lessened by this procedure.

Food poisoning due to infection with the several paratyphoid bacilli of animal origin or to intoxication with their products may undoubtedly be prevented to some extent by making sure that only healthy animals are used for food. The recognition that the bodies of animals dying a natural death are not altogether fit for food is very ancient. The twenty-first verse of the fourteenth chapter of Deuteronomy reads: "Ye shall not eat of anything that dieth of itself; thou mayest give it unto the sojourner that is within thy gates that he may eat it; or thou mayest sell it unto a foreigner." There is general agreement at the present day that milk or meat from ailing animals should not be allowed to come on the market, and so far as it is possible to prevent the consumption of food so derived, in so far will outbreaks of food poisoning be diminished. It is plain that this can best be achieved, not by inspection of the foodstuff but by careful examination of the living food animals.

### Cooking Food a Safeguard

It seems to be true also that the thorough cooking of food just before serving is in some degree a safeguard. In numerous outbreaks an article of food, raw or partly cooked, has given rise to illness, while the same article consumed after cooking has had no bad effect. In view of the heat stability of the poisonous substances present in paratyphoid bacilli, the apparent protection conferred by cooking is worthy of further epidemiological inquiry.

The possibility of food contamination by rats and mice has already been mentioned. *The use of commercial rat viruses containing mem-*

*bers of the paratyphoid group—generally B. enteritidis—constitutes a hazard to public health and should be prohibited.* (Italics ours.) Not only is there already on record a formidable list of outbreaks, some of them attended by fatalities, due to direct human infection with these viruses, but animal carriers may be produced, leading to a wide dispersion of a dangerous pathogen.

Apparently vermin that have never been exposed to rat viruses may also carry these organisms. That wild rats in the United States do actually harbor paratyphoid bacilli has been shown by the observations of Miss Verder in Chicago in 1925 and more recently and more extensively by Meyer and his associates in San Francisco. Anyone examining the published reports of outbreaks of food poisoning must be impressed by the considerable number of instances in which it has been impossible to trace any connection with a food handler or an infected food animal and in which contamination by house vermin seems to have been possible and in some cases highly probable. It is likely that this source of paratyphoid food poisoning has been somewhat overlooked or underestimated and that eventually a considerable proportion of the outbreaks of this nature will be found due to the contamination of food by rats or mice.

REFERENCES

(1) J. Hyg. 17: 460, 1918.
(2) Am. J. Hyg. 7: 27, 1927.
(3) Brit. Med. J. 2: 857, 1924.

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## AN OUTBREAK OF OTITIS MEDIA (OTOMYCOSIS) AT GATUN LAKE, CANAL ZONE

By J. K. Gordon, Lieutenant, Medical Corps, United States Navy

Destroyers of divisions Nos. 34, 35, and 36 of the Battle Fleet, seven in number, arrived and were moored alongside their tender, anchored in Gatun Lake, Canal Zone, on June 10, 1927.

The following morning, while the writer was on board the tender during morning sick call, he was requested by the medical officer of the ship to examine a patient who had an acute condition involving one of his ears. The medical officer stated that 15 patients were under treatment for a similar disease, and that all the patients requested treatment at or about the same time, or about four days after the tender had arrived at Gatun.

One June 13, 1927, or the third day after they had anchored in the lake, the same condition began to appear among the officers and men attached to the destroyers, and within the next four days an average of 10 cases developed among the personnel of each of the seven destroyers. The symptoms presented by some of the patients were comparatively mild, while with others they were much more severe.

It became apparent soon after the outbreak developed that we had to deal with an infection having a common source, and efforts were directed toward preventing a further spread of the disease. In searching for a possible cause, it seemed reasonable to believe that swimming in the waters of Gatun Lake, which was permitted by all the ships present as a part of their recreational program, might have some connection with the spread of the infection. Accordingly, all patients when interviewed with this in mind stated, without exception, that they had been swimming once or twice daily during the three or four days prior to the onset of symptoms. It was therefore recommended that all swimming in Gatun Lake be stopped, and this recommendation was immediately placed in force.

It is not practicable in this article to report each case in detail so I shall give a general résumé of the symptoms presented. Most of the patients upon reporting stated that they had a sensation suggestive of water in the external ear accompanied by an intense itching, while a few complained of a dull pain only. The following day all had severe pain in one or both ears. They stated that they experienced pain when the auricle was touched, tenderness about the mastoid, and over the area of the postauricular group of lymph nodes, and deafness. Most of the patients were unable to sleep on account of the increased pain at night, and many had a slight fever, which, however, did not exceed 100° F. The external auditory canal was edematous and partially occluded and, in the more severe cases, completely occluded, with forward displacement of the auricle. Upon otoscopic examination, the lining of the external canal appeared to be acutely inflamed and either partially or completely filled with a brownish yellow or a dark gray to black membrane. This could only be removed with difficulty and with the production of considerable pain, leaving the canal in a raw and bleeding condition. After the removal of the exudate the drum membrane could be seen. In most instances it was covered with the same type of exudate as that noted in the canal. In none of the cases did the drumhead appear to be distorted, except that it was thickened.

The treatment consisted of careful mechanical removal of all the membrane possible by means of applicators wound with cotton, special care being taken not to injure or touch the drumhead. The external canal was then filled with a solution of 5 per cent salicylic acid in equal parts of alcohol and boric acid, which was retained for five minutes, after which a loose cotton drain saturated in a 2 per cent solution of salicylic acid in alcohol and boric acid was introduced as far as the drumhead and left until the next treatment. Pain was combated by the application of heat to some cases and cold to others, depending upon which seemed to give the most com-

fort. In the more pronounced cases, the pain at night was alleviated by the administration of codeine. The average length of time under treatment was four days, but two cases, complicated by a perforation of the drum membrane, required treatment for nearly a month before a cure was effected.

The term "otomycosis" is used, as stated by Kerrison, to describe the condition in which some form of mold has found lodgment and conditions favorable for its development in the external auditory canal. It may be confined to the wall of the bony meatus, or may spread thickly over the drum membrane. The fungus may simply inhabit the meatus without causing any morbid changes in the tissues upon which it grows, in which case it gives rise to no symptoms whatever; and this is the condition found in over one-third of all cases (Bezold). In other cases the Hyphomycetes may invade the tissues, the mycelia perforating the lining membrane of the bony canal and the skin covering the drum membrane and giving rise to an acute inflammatory process.

But little is definitely known as to the cause of the infection in the ear beyond the fact that molds require warmth and moisture for their growth. Oils and fatty matter form a suitable nidus for the development of molds, and Bezold obtained in 75 per cent of all cases examined by him a definite history of the patient having instilled medicaments containing oil or glycerin into the ear.

Bishop states that the common use of oils by the laity predisposes to this disease, as does any decomposing secretion or substance in the ear. According to Wales, a very profuse discharge, however, seems to be prohibitive to the development of the fungus, owing, perhaps, to the fact that the spores are washed away before they can attach themselves, or that they are quickly drowned in the excess of fluid present. Among the many different molds that have been identified in specimens taken from the ear are the *Aspergillus niger*, *Aspergillus flavus*, *Aspergillus nidulans*, and the *Verticillium graphii*.

As no new cases developed after the swimming in Gatun Lake was discontinued, this small epidemic is regarded as undoubtedly due to the presence in great numbers of the Hyphomycetes group of molds, of which the *Aspergillus niger* and the *Aspergillus flavus* seemed to predominate, in the waters of Gatun Lake.

Editor's note.—In a recent communication from the board of health laboratory, Ancon, Canal Zone, it is stated that they have no data as to the water of Gatun Lake causing mycotic infection of the external ear. Such infection is not uncommon in the Canal Zone, and leaving the external auditory canal wet after bathing is believed to be a predisposing factor in the occurrence of an outbreak of such infections.

## AMENDMENTS TO THE INTERNATIONAL RULES OF ZOOLOGICAL NOMENCLATURE

At the request of Prof. Ch. Wardell Stiles, of the United States Public Health Service, the following article, which appeared in the October 28, 1927, number of the Public Health Reports, is reprinted for the information of the service:

ARTICLE 25. The valid name of a genus or species can be only that name under which it was first designated on the condition—

(*a*) That (*prior to January 1, 1931*) this name was published and accompanied by an indication, or a definition, or a description; and

(*b*) That the author has applied the principles of binary nomenclature.

(*c*) *But no generic name nor specific name published after December 31, 1930, shall have any status of availability* (*hence, also of validity*) *under the rules, unless and until it is published either—*

(1) *With a summary of characters* (*seu diagnosis; seu definition; seu condensed description*) *which differentiate or distinguish the genus or the species from other genera or species;*

(2) *Or with a definite bibliographic reference to such summary of characters* (*seu diagnosis; seu definition; seu condensed description*). *And further—*

(3) *In the case of a generic name, with the definite unambiguous designation of the type species* (*seu genotype; seu autogenotype; seu orthotype*).

The purpose of this amendment is to inhibit two of the most important factors which heretofore have produced confusion in scientific names. The date January 1, 1931, was selected (instead of making the amendment immediately effective) in order to give authors ample opportunity to accommodate themselves to the new rule.

The commission unanimously adopted the following resolution:

(*a*) It is requested that an author who publishes a name as new shall definitely state that it is new, that this be stated in only one (i. e., in the first) publication, and that the date of publication be not added to the name in its first publication.

(*b*) It is requested that an author who *quotes* a generic name, or a specific name, or a subspecific name shall add at least once the author and year of publication of the quoted name or a full bibliographic reference.

The foregoing resolution was adopted in order to inhibit the confusion which has frequently resulted from the fact that authors have occasionally published a given name as "new" in two to five or more different articles of different dates—up to five years in exceptional cases.

The three propositions submitted by Dr. Franz Poche, of Vienna, failed to receive the necessary number of votes in commission to

permit of their being recommended to the Congress. Out of a possible 18 votes for each proposition, Poche's proposition I received 9 votes, II received 6 votes, and III received 7 votes.

Zoological, medical, and veterinary journals throughout the world are requested to give to the foregoing the widest possible publicity in order to avoid confusion and misunderstanding.

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## HEALTH OF THE NAVY

The general admission rate from all causes based on returns for October, November, and December, 1927, was 478 per 1,000 per annum. This rate is slightly lower than that for the preceding quarter, which was 527, and lower than the median rate for the preceding five years, which is 520. This decrease in the rate is due to fewer admissions for acute catarrhal fever and venereal diseases for the quarter. The admission rate from accidental injuries was 63 per 1,000 per annum during the quarter. The fatalities incurred in the sinking of the U. S. S. *S-4* on December 17, 1927, are included in this rate. Records of the preceding five years show that the median rate for accidents and injuries for the coresponding three months is 75.

An outbreak of acute catarrhal fever appeared at the United States naval training station, Great Lakes, in December, when 136 admissions were reported. There were 61 admissions at this station for this disease in October, and 45 in November, making a total of 242 for the quarter. One fatal case of cerebrospinal fever, that developed in the case of an apprentice seaman who had been admitted to the sick list with acute catarrhal fever, was reported from the Pharmacist's Mates' School, Portsmouth, Va.

Reports from forces afloat indicate that morbidity rates for diseases and accidents and injuries were considerably less than expectancy. The median rate for the quarter was 382 per 1,000 per annum as compared with the corresponding median rate for the preceding five years, which is 464. Thirteen cases of measles were reported by the U. S. S. *New York* during the month of October and 3 in November. One case of cerebrospinal fever, terminating fatally, was reported by the U. S. S. *Mississippi* in October and one by the U. S. S. *Bridge* in November.

Thirty-three of the 44 drownings and the 6 deaths from carbon dioxide poisoning reported during the quarter were due to the sinking on December 17, 1927, of the submarine U. S. S. *S-4* near Provincetown, Mass.

**Table No. 1.**—*Summary of morbidity in the United States Navy and Marine Corps for the quarter ended December 31, 1927*

| | Forces afloat | Forces ashore | Marine Corps | Entire Navy |
|---|---|---|---|---|
| Average strength | 78, 316 | 36, 592 | 19, 708 | 114, 908 |
| All causes: | | | | |
| Number of admissions | 7, 472 | 6, 267 | 2, 605 | 13, 739 |
| Annual rate per 1,000 | 381. 63 | 685. 06 | 528. 72 | 478. 25 |
| Disease only: | | | | |
| Number of admissions | 6, 401 | 5, 477 | 2, 321 | 11, 878 |
| Annual rate per 1,000 | 326. 93 | 598. 71 | 471. 08 | 413. 47 |
| Communicable diseases, exclusive of venereal disease: | | | | |
| Number of admissions | 1, 549 | 2, 164 | 796 | 3, 713 |
| Annual rate per 1,000 | 79. 12 | 236. 55 | 161. 56 | 129. 25 |
| Venereal diseases: | | | | |
| Number of admissions | 2, 375 | 1, 008 | 637 | 3, 383 |
| Annual rate per 1,000 | 121. 30 | 110. 19 | 129. 29 | 117. 76 |
| Injuries: | | | | |
| Number of admissions | 1, 016 | 778 | 284 | 1, 794 |
| Annual rate per 1,000 | 51. 89 | 85. 05 | 57. 64 | 62. 45 |
| Poisoning: | | | | |
| Number of admissions | 55 | 12 | 0 | 67 |
| Annual rate per 1,000 | 2. 81 | 1. 31 | 0 | 2. 33 |

**Table No. 2.**—*Deaths reported, entire Navy, during the quarter ended December 31, 1927*

| | | Navy | | | Marine Corps | | Nurse Corps, nurses | Total |
|---|---|---|---|---|---|---|---|---|
| | | Officers | Midshipmen | Men | Officers | Men | | |
| Average strength | | 8, 837 | 1, 535 | 84, 350 | 1, 197 | 18, 511 | 478 | 114, 908 |
| **Causes: Diseases** | | | | | | | | |
| Primary | Secondary or contributory | | | | | | | |
| Abscess: | | | | | | | | |
| Brain | None | | | 2 | | | | 2 |
| Liver, entamebic | do | | | 1 | | | | 1 |
| Retroperitoneal | Peritonitis, general, acute | | | | | 1 | | 1 |
| Alcoholism, acute | None | | | | | 1 | | 1 |
| Do | Asphyxiation, food bolus | | | | | 1 | | 1 |
| Appendicitis, chronic | Obstruction, intestinal, from external causes. | | | 1 | | | | 1 |
| Carcinoma, liver | Myocarditis, chronic | | | 1 | | | | 1 |
| Cellulitis: | | | | | | | | |
| Left hand | Septicemia | | | 1 | | | | 1 |
| Left leg | do | | | 1 | | | | 1 |
| Cerebrospinal fever | None | | | 2 | | | | 2 |
| Do | Obstruction, intestinal, from internal causes. | | | 1 | | | | 1 |
| Cholangitis, acute | Nephritis, acute | | | 1 | | | | 1 |
| Dysentery, entamebic | Pneumonia, broncho | | | 1 | | | | 1 |
| Endocarditis, acute | Pericarditis | | | 1 | | | | 1 |
| Gastritis, acute | Dilatation, cardiac, acute | 1 | | | | | | 1 |
| Influenza | Septicemia | | | 1 | | | | 1 |
| Leukemia | None | | | 1 | | | | 1 |
| Malaria | Myocarditis, acute | | | 1 | | | | 1 |
| Measles | Pneumonia, broncho | | | | | 1 | | 1 |
| Myocarditis, chronic | Dilatation, cardiac, acute | | | 1 | | | | 1 |
| Nephritis: | | | | | | | | |
| Acute | None | | | 1 | | | | 1 |
| Chronic | Arteriosclerosis, general | 1 | | | | | | 1 |
| Paralysis, ascending, acute. | None | | | | | 1 | | 1 |
| Pneumonia, lobar | do | | | 2 | | | | 2 |
| Do | Endocarditis, acute | | | 1 | | | | 1 |
| Septicemia | None | | | 1 | | | | 1 |
| Syphilis | Myelitis, transverse | | | 1 | | | | 1 |
| Do | Poisoning, acute, neo-salvarsan | | | 2 | | | | 2 |
| Tuberculosis, chronic, pulmonary. | None | | | 2 | | | | 2 |
| Do | Tuberculosis, knee and spine | | | 1 | | | | 1 |
| Valvular heart disease, aortic insufficiency. | Nephritis, acute | | | 1 | | | | 1 |
| Total for diseases | | 2 | | 30 | | 5 | 1 | 38 |

TABLE No. 2.—*Deaths reported, entire Navy, during the quarter ended December 31, 1927*—Continued

| | | Navy | | | Marine Corps | | Nurse Corps, nurses | Total |
|---|---|---|---|---|---|---|---|---|
| | | Officers | Midshipmen | Men | Officers | Men | | |
| **Average strength** | | 8,837 | 1,535 | 84,350 | 1,197 | 18,511 | 478 | 114,908 |
| **CAUSES: INJURIES AND POISONING** | | | | | | | | |
| **Primary** | **Secondary or contributory** | | | | | | | |
| **Asphyxiation:** | | | | | | | | |
| Carbon dioxide | None | 1 | | 5 | | | | 6 |
| Carbon monoxide | do | | | 1 | | | | 1 |
| Illuminating gas | do | | | 2 | | | | 2 |
| **Burns, multiple:** | | | | | | | | |
| Flame | do | | | 1 | | | | 1 |
| Steam | do | | | 1 | | | | 1 |
| Gas explosion | Thrombosis, cerebral | | | 1 | | | | 1 |
| **Electric shock, injuries from.** | None | | | 1 | | 1 | | 2 |
| **Fracture:** | | | | | | | | |
| Compound, skull | do | | | 1 | | | | 1 |
| Do | Intracranial injury | | | 1 | | | | 1 |
| Simple, skull | None | | | 1 | | | | 1 |
| **Intracranial injury** | do | | | 1 | | | | 1 |
| **Injuries, multiple, extreme.** | do | | | 6 | | | | 6 |
| **Landplane crash: Injuries, multiple, extreme.** | do | 4 | | | | | | 4 |
| Do | Edema of lung | | | 1 | | | | 1 |
| Do | Psychosis, manic, depressive | | | 1 | | | | 1 |
| **Wound:** | | | | | | | | |
| Penetrating— | | | | | | | | |
| Brain | None | | | 2 | | 4 | | 6 |
| Chest | do | | | 2 | | | | 2 |
| Right thigh | Aerogenes capsulatus infection, leg. | | | 1 | | | | 1 |
| Lumbar region | None | | | | | 1 | | 1 |
| Punctured, casualty in action. | do | | | | | 1 | | 1 |
| **Wounds, multiple:** | | | | | | | | |
| Gunshot | do | | | | | 1 | | 1 |
| Extreme | do | | | | | 1 | | 1 |
| **Drowning** | do | 5 | | 38 | | 1 | | 44 |
| **Poisoning, acute:** | | | | | | | | |
| Nicotine | do | | | 1 | | | | 1 |
| Bichloride of mercury. | do | | | 1 | | | | 1 |
| Total for injuries and poisonings | | 10 | | 69 | | 10 | | 89 |
| Grand total | | 12 | | 90 | | 15 | 1 | 118 |
| Annual death rate per 1,000, all causes | | 5.43 | | 4.69 | | 3.24 | 8.37 | 4.42 |
| Annual death rate per 1,000, disease only | | .91 | | 1.42 | | 1.08 | 8.37 | 1.38 |
| Annual death rate per 1,000, drowning | | 2.26 | | 1.80 | | .22 | | 1.57 |
| Annual death rate per 1,000, injuries | | 2.26 | | 1.28 | | 1.94 | | 1.46 |
| Annual death rate per 1,000, poisoning | | | | .09 | | | | .07 |

## STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following tables were constructed with figures taken from monthly reports submitted by naval training stations:

*Cumulative data*

| | Number | Per cent of recruits received | Per cent of recruits reviewed |
|---|---|---|---|
| JAN. 1 TO DEC. 31, 1926 | | | |
| All naval training stations: | | | |
| Recruits received during the period | 16, 212 | | |
| Recruits appearing before board of medical survey | 842 | 5. 19 | |
| Recruits recommended for discharge from the service | 496 | 3. 06 | 58. 91 |
| OCTOBER, NOVEMBER, AND DECEMBER, 1927 | | | |
| United States naval training station, Hampton Roads, Va.: | | | |
| Recruits received during the period | 1, 023 | | |
| Recruits appearing before board of medical survey | 50 | 4. 89 | |
| Recruits recommended for discharge from the service | 50 | 4. 89 | 100. 00 |
| United States naval training station, Great Lakes, Ill.: | | | |
| Recruits received during the period | 1, 202 | | |
| Recruits appearing before board of medical survey | 27 | 2. 25 | |
| Recruits recommended for discharge from the service | 22 | 1. 83 | |
| United States naval training station, San Diego, Calif.: | | | |
| Recruits received during the period | 677 | | |
| Recruits appearing before the board of medical survey | 19 | 2. 81 | |
| Recruits recommended for discharge from the service | 19 | 2. 81 | 100. 00 |
| United States naval training station, Newport, R. I.: | | | |
| Recruits received during the period | 1, 087 | | |
| Recruits appearing before board of medical survey | 121 | 11. 13 | |
| Recruits recommended for discharge from the service | 25 | 2. 30 | 20. 66 |

## ADMISSIONS FOR INJURIES AND POISONING, FOURTH QUARTER, 1927

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the fourth quarter, 1927, is based upon all Form F cards covering admissions in those months which have reached the bureau:

| | Admissions, October, November, and December, 1927 | Admission rate per 100,000 per annum | Admission rate per 100,000, year 1926 |
|---|---|---|---|
| INJURIES | | | |
| Connected with work or drill | 864 | 3, 008 | 3, 036 |
| Occurring within command but not associated with work | 580 | 2, 019 | 2, 017 |
| Incurred on leave or liberty or while absent without leave | 350 | 1, 218 | 1, 086 |
| All injuries | 1, 794 | 6, 245 | 6, 139 |
| POISONING | | | |
| Industrial poisoning | 13 | 45 | 53 |
| Occurring within command but not connected with work | 40 | 139 | 195 |
| Associated with leave, liberty, or absence without leave | 14 | 49 | 126 |
| Poisoning, all forms | 67 | 233 | 374 |
| Total injuries and poisoning | 1, 861 | 6, 478 | 6, 513 |

*Percentage relationships*

| | Occurring within command | | | | Occurring outside command—leave, liberty, or A. W. O. L. | |
|---|---|---|---|---|---|---|
| | Connected with the performance of work, drill, etc. | | Not connected with work or prescribed duty | | | |
| | October, November, and December, 1927 | Year 1926 | October, November, and December, 1927 | Year 1926 | October, November, and December, 1927 | Year 1926 |
| Per cent of all injuries | 48.2 | 49.4 | 32.3 | 32.9 | 19.5 | 17.7 |
| Per cent of poisonings | 19.4 | 14.1 | 59.7 | 52.2 | 20.9 | 33.7 |
| Per cent of total admissions, injury and poisoning titles | 47.1 | 47.4 | 33.3 | 34.0 | 19.6 | 18.6 |

Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction," or "Alcoholism," as the case may be. Such cases are not included in the above figures.

The following cases, selected from October, November, and December, 1927, reports are worthy of notice from the standpoint of accident prevention:

*Hatch-cover hazards.*—A hatch cover on board a destroyer was left open without being properly secured. The roll of the ship caused the cover to fall while a man was passing through. He received a fracture of an arm and was on the sick list 29 days to the end of the year. The final result has not been reported.

An improperly secured hatch cover of a battleship fell on the hand of a man who was passing through. He received lacerated wounds of two fingers. Loss of time, 21 days.

A similar accident on board another battleship caused 17 sick days.

*Hatchway hazards.*—A hatch was left unguarded after the ladder had been removed. A man fell astraddle the knife edge of the combing. Result, rupture of the urethra. Loss of time, 40 days.

*Gasoline hazards.*—Two men were playing cards on a gasoline drum, which was thought to be empty, as a table. The gasoline fumes were ignited by a lighted cigarette, and an explosion occurred. Both men received burns about the hands and face. Loss of time, 3 days.

A man, while passing by, dropped a lighted match into a bucket containing gasoline-soaked rags, which was left unprotected on the deck of a ship. The rags ignited and burned the leg of another man's trousers. Result, burn of leg. Loss of time, 5 days.

While a shipfitter was heating an apparently empty gasoline drum with a blowtorch, an explosion occurred which resulted in a burn of the man's back. Loss of time, 5 days.

*Starting an engine without warning.*—While a boatswain's mate was chipping paint from an anchor engine the engine was started without warning by another man. He received a contusion of the hip. Loss of time, 2 days.

*Unsafe practice—Cleaning machinery while in motion.*—A man attempted to clean a dough-mixing machine while it was in motion. His hand was caught in the machinery and he lost the end of a finger. He was treated for 33 days on the sick list and finally invalided from the service.

*Flying particles—Lack of eye protection.*—A seaman without goggles was working with a portable power drill on the side of a ship. Flying particles from the drill injured an eye. Loss of time, 5 days.

*Unsafe practice—Lack of eye protection.*—Due to negligence of others an officer was allowed to work with an electric torch without wearing protective goggles. Irritation of the eyes from the intense light caused 6 days' loss of time.

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VOL. XXVI JULY, 1928 No. 3

# UNITED STATES NAVAL MEDICAL BULLETIN

PUBLISHED QUARTERLY FOR THE INFORMATION OF THE MEDICAL DEPARTMENT OF THE NAVY

*Issued by*

THE BUREAU OF MEDICINE AND SURGERY
NAVY DEPARTMENT

DIVISION OF PLANNING AND PUBLICATIONS
CAPTAIN J. M. BRISTER, MEDICAL CORPS, U. S. NAVY
IN CHARGE

*Edited by*

COMMANDER L. SHELDON, JR., MEDICAL CORPS
U. S. NAVY

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NAVY DEPARTMENT,
*Washington, March 20, 1907.*

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
*Acting Secretary.*

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Volume VII, No. 2, April, 1913.
Volume VIII, No. 1, January, 1914.
Volume VIII, No. 3, July, 1914.
Volume VIII, No. 4, October, 1914.
Volume X, No. 1, January, 1916.
Volume XI, No. 1, January, 1917.
Volume XI, No. 3, July, 1917.
Volume XI, No. 4, October, 1917.
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# PREFACE

The UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April, 1907, as a means of supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, reports from various sources, historical essays, notes and comments on topics of medical interest, and reviews, or notices of the latest published medical books.

The bureau extends an invitation to all medical officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of commendation to authors of papers of outstanding merit and will recommend that copies of such letters be made a part of the official records of the officers concerned.

The bureau does not necessarily undertake to indorse all views or opinions which may be expressed in the pages of this publication.

E. R. STITT,
*Surgeon General United States Navy.*

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U. S. NAVAL MEDICAL BULLETIN

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## SPECIAL ARTICLES

### HEAT STROKE A THERMOREGULATORY INCOMPETENCY[1]

WITH PATHOLOGICAL FINDINGS

By EBEN E. SMITH, Lieutenant Commander, Medical Corps, United States Navy

Kinetic energy in its physical manifestation, appreciated as heat, presents a phenomenon of the utmost importance in the maintenance of life. The scientist is able to find nothing in life except highly organized and systematized energy. He does not question that there may be some higher guiding purpose above and beyond his materialistic field of speculation and tangible analysis.

Several biological facts relative to heat may be accepted. Heat is an essential factor in the maintenance of life. Heat is relative in degree. Protoplasmic life is limited to a relatively small portion of the range of temperature variation. The more complex the form of biological organization the more limited is its tolerance of variation. Optimum temperatures vary with different forms of life.

Heat has always been of prominent importance to the human race. History is largely the chronicle of the mastery of mind over heat. Not many generations removed heat was acquired laboriously and the race, by habit and habitat, rarely suffered from excess. Rather, activity and zone inhabited were restricted by limited supply of heat. Conditions have changed. No longer is the race compelled to fight for its heat. Environmental temperatures are so well controlled, and refined food, particularly sugar, is so abundant that rarely does the individual want for either.

This progress is being purchased at some cost. New conditions of altered environment have been created and some of these are detrimental to the organism. Dublin and Liboff, of the Metropolitan Life Insurance Co.,[2] reporting on hazardous occupations list 109

[1] From U. S. Naval Medical School, Washington, D. C. Presented (by title) at the twenty-fourth annual meeting of the American Society of Tropical Medicine, Washington, D. C., May 8, 1928.

[2] U. S. N. Med. Bul., 17: 883, 1922.

industrial occupations as presenting health hazards due to exposure to extreme dry heat, and list 72 presenting hazards due to sudden variations of temperature. Hardly an industry is exempt. Even the average office and home are not above criticism.

Physiological adaptation has not kept pace with the rapid evolution of environment. Compensation for heat is the normal mechanism. Compensation for heat acquired from environment represents a new and relatively artificial condition. Even existence in a uniformly comfortable environment fails to provide a physiological ideal, as Huntington[3] has shown in his analysis of the progress of civilization and his analysis of the effect of climate upon industrial efficiency. He concludes that the human organism is adapted to a temperature averaging 60° to 70° F., and that existence of many generations in tropical or arctic conditions has failed to alter this adaptability in favor of existence in these altered temperature environments. Winternitz[4] concluded from basal metabolic determinations that the optimum environmental temperature at rest is about 30° C. (86° F.). These figures confirm Rubner's calculations and approximate more recent observations. From investigations on the effect of various atmospheric conditions on industrial workers, the New York State Commission on Ventilation[5] concluded the optimum to be: Temperature 68° F., relative humidity 50 per cent, air supply at the rate of 45 cubic feet per person per minute. Departures from this optimum environmental temperature lead to physiological reactions and loss of efficiency. Excessive deviation may result in responses of clinical or pathological significance. The present discussion is concerned with temperatures above this optimum.

The human body functions at a temperature that is almost constant. This normal represents, we may presume, that optimum of heat which is most conducive to efficient biochemical function of the protoplasm of the human body. This normal is approximately 98.4° F. (36.8° C.), and it is surprisingly constant considering the marked stress placed upon the thermoregulatory mechanism by variable environmental and metabolic influences. However, deviation from this mean does occur and may be physiological or pathological in origin. A diurnal variation has been observed and reported, the minimum occurring about 4 to 6 in the morning and the maximum about 12 hours later. Pembrey and Nichols[6] found this to aproximate 1.25° C. No satisfactory explanation has been proposed

[3] Civilization and Climate, New Haven, 1924, 3d edition.
[4] Klin. Jahre, Berlin, Bd. VII, S. 299 (1899).
[5] Ventilation, 1923, p. 620.
[6] Guy's Hospital Report, Vol. LVII, p. 283, 1902.

for this. MacLeod[7] observes that this variation is not altered in persons whose habits are reversed to a nocturnal activity. Gibson, Osborne, and Lindhard have separately observed that a reversal does occur, and Simpson reports that birds, nocturnal in habit, also have a reversal of this temperature variation.

Exercise and increased metabolic activity are known to increase temperature. Elevations of 2° to 3° F., have been observed under influence of strenuous exercise. Pathologically increased temperature, clinically fever, is a common response to disease, and as such may represent either a transitory defense mechanism of utility in reacting to some antigen or a temporary instability of the thermoregulatory mechanism. Whatever the cause, accelerated metabolism develops or results. As a prolonged condition, increased temperature represents a poor biochemical economy, as is often noted clinically in the exhaustion and debility associated with fever. Clinicians have long known that moderate rise in body temperature lowers efficiency and causes increased irritability, and excessive temperature results in serious protoplasmic trauma. When a rising temperature reaches 106° F., further rise must be prevented. Temperatures above this figure are of serious prognosis, and the temperature that reaches 110° F. is rare. Death in such cases of hyperthermia can not be attributed solely to heat, as there is an associated trauma and disturbed metabolic activity. However, heat must play a very important rôle.

The present discussion is concerned with those phenomena resulting from failure of a normal individual to maintain normal physiology under influences favorable to heat accumulation.

Several fairly characteristic types of response have been observed clinically when compensation is broken. In heat exhaustion there is a terminal syncopal exhaustive vasomotor and thermoregulatory collapse following an initial and usually protracted period of compensation under stress. The temperature is usually normal or subnormal and the skin moist and cool. Milder forms of incapacity are commonly classed as heat prostration. In contrast, thermic fever is heat accumulation in which exposure is usually more severe, onset more sudden, and decompensation develops relatively early and is manifested by stoppage of perspiration, dry skin, hyperpyrexia, and increased vascular tone, particularly of the left ventricle. Occasionally thermic fever instead of heat exhaustion may be the terminal event after prolonged exposure, especially in cases of decompensation due to depletion of fluids. "Sunstroke" is heat stroke resulting from direct exposure to the sun's rays. Clinically and pathologically

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[7] Physiology and Biochemistry in Modern Med., 5th ed., Ch. XCVI.

the condition may duplicate in severity and type any of the above forms. Etiologically, however, there is good experimental and empirical reason to presume that the heat rays are only partially responsible for the results.

The actinic rays, although representing only approximately 1 per cent of the spectrum, are powerful stimulants or irritants to the living cells. The severe form of sunstroke can surpass all other forms of heat stroke in rapidity of onset and suddenness of death. Severe burns and pigmentation bear testimony to the physiological importance of the effect of these rays on the skin and recent investigation demonstrates their importance in metabolism. Heat cramps is a closely related condition in which failure apparently results from some alteration in blood constituents, probably depletion in the water and saline content of the blood and tissues. All represent various pathologic responses to the same basic etiology. Under identical environmental conditions these various types of reaction have been manifested simultaneously in different patients. These types are not clear-cut entities, the symptomatology overlapping, and the literature is confusing, due to the absence of a generally accepted uniform terminology. The present discussion is concerned only incidentally with the clinical manifestations of the disturbances indexed as heat stroke and hyperpyrexia. For convenience they may be regarded as closely related types of reaction, each being a manifestation of thermoregulatory incompetency.

The mechanism whereby balance is maintained between heat production and heat accumulation on one hand and heat dissipation on the other involves a very complex physiological process in which many combinations of conditions are possible.

Physiologists agree on a nervous control but fail in an agreement on anatomical localization of the center of control. Starling[8] suggests that the control is effected through two separate centers; one thermogenic, controlling heat production, and the other thermotaxic, a governing center which balances heat loss and heat production. The localization or actual existence of these centers is indefinite. Wood, in 1880, and numerous investigators since, including Ott, Aronshon and Sacks, Babinsky and Lehman, White, Ito, Aisenstat, Streerath, Nikolaides and Dontas, Jacoby and Roemer, Isenschmidt and Schnilzler, and others have experimentally concluded that there is a heat regulatory center. These various investigators have variously proposed the following areas: (1) First cerebral convolution posterior to and in the vicinity of the sulcus cruciatus, (2) anterior inner end of the optic thalamus, (3) medial aspect of the corpus striatum, (4) tuber cinerium.

[8] Human Physiology, 1926.

Barbour [9] found that by heating and cooling the corpus striatum he obtained a compensatory reaction, in that heating caused a fall in body temperature and cooling accelerated metabolic processes with a resultant rise.

In opposition to this localization, Kornblum [10] came to the conclusion that there is no definite area in the brain whose sole function is heat regulation and that heat regulation is effected through widely distributed reflex arcs. He produced lesions in dogs in the optic thalamus, corpus striatum, pons, medulla, corpus callosum, internal capsule, corona radiata, cortex, nucleus amygdale, and pituitary gland. Radium, electric current, trauma, and injections of chloroform, cerebrospinal fluid, and blood were employed. He produced maximum temperature of 106.1° F. (41.2° C.). Sachs and Green, and Moore also failed to find any localization.

Whatever the localization may be, Starling concludes that the center is apparently in the medulla, that it acts through the sympathetic control over the vascular supply to the skin, that it controls the function of the sweat glands, and, we may presume, also affects endocrine function. Injury to this center results in hyerpyrexia without compensatory heat loss. It is this mechanism that controls heat accumulation on one hand and heat dissipation on the other so as to preserve a normal physiological balance.

Heat accumulation is dependent very largely upon the oxidative processes of metabolism. The normal basal metabolic rate approximates one calorie (large) per kilo body weight per hour (MacLeod [7]). This is the minimal heat production with the body at complete rest except for the essential vital functions. It is a rate which can not be permanently maintained. At this basal rate the body consumes food products that must be eventually replaced. Addition of ordinary diet sufficient to satisfy this demand increases this rate by about 10 per cent due to the specific dynamic action of foods, in that they liberate heat while undergoing digestion (protein 30 per cent, fat 11 per cent, carbohydrates 5.8 per cent). Du Bois [11] has shown that the basal rate closely follows the surface area law and he has evolved a very useful formula whereby this area may be calculated from height and weight.

Benedict [12] has modified these calculations by the additional variable factors of age and sex. There are also other modifying factors more difficult to incorporate in arbitrary equations. It is known

[7] See footnote 7 on p. 481.
[9] Arch. f. Exper. Path. u. Pharmacol., 70: 1, 1912.
[10] Arch. Neurology and Psychiatry, 13: 755, 1925.
[11] Clinical Chemistry, Papers 1–25, Arch. Int. Med., 1915–1917.
[12] Benedict: Am. Jour. Physiol., 1916.

that the state of nutrition is a modifying factor, the rate decreasing during starvation and being increased in the athlete (MacLeod[7]).

Douglas and Haldane[13] determined the oxygen consumption under conditions of variable degree of activity. Allowing 4.8 calories for each liter of oxygen consumed the following heat production in large calories per hour may be calculated, assuming an average diet:

On waking, in bed, 68.25 calories.
At rest, standing, 95.04 calories; increment, 39 per cent.
Walking, 2 miles per hour, 224.64 calories; increment, 229 per cent.
Walking, 3 miles per hour, 306.72 calories; increment, 349 per cent.
Walking, 4 miles per hour, 459.36 calories; increment, 573 per cent.
Walking, 5 miles per hour, 732.38 calories; increment, 973 per cent.

Utilization of calories in excess of the basal rate and specific dynamic action of metabolism is in the form of tissue growth and repair and work, primarily work. Heat production occurs in the active protoplasm of the body (Benedict[12]), chiefly the muscles, and a warm-blooded animal becomes poikilothermos when the motor terminals are paralyzed with curare (MacLeod[7]). Muscle tone and muscular work, therefore, account for the chief supply of heat. The trained muscle working under most favorable conditions has an efficiency little in excess of 30 per cent, and ordinary muscular exertion falls below this figure. Consequently, over 70 per cent of the caloric requirement for work must be dissipated as heat. The ingestion of foods and fluids of high temperature is a minor source of heat. Usually heat is lost rather than gained through this source. In cold environment there is a tendency to accumulate some heat this way, but under conditions of high temperature there is a definite tendency to ingest fluids below body temperature.

The only other source of heat is to accumulate it from an environment which has a temperature above that of the body. It may be climatic or industrial in origin and each field has furnished much interesting research. Environmental influences involving exposure to temperatures approaching blood heat are relatively exceptional. During the calendar years 1923–1927, inclusive, there were 555 hours, or 1.27 per cent of the total time, when the Weather Bureau reports temperatures above 90° F. (32.2° C.), in this locality. Temperatures much in excess of this are encountered in equatorial latitudes and in many industries; but the fact remains that the body mechanism is primarily adusted to an environment definitely below blood heat and normally functions to maintain heat rather than to promote heat loss.

Heat dissipation is dependent upon complex physical and physiological factors. There is an interchange of heat between the body

[7] See footnote 7 on p. 481.
[12] See footnote 12 on p. 483.
[13] Douglas and Haldane: Jour. of Physiol., 45:236, 1912.

and its environment, ordinarily at the expense of the body. This takes place by means of conduction, convection, and radiation. Conduction increases with increase of humidity. Convection increases proportional to the square root of air velocity. Radiation is proportional to difference in temperature between the body and the air. Clothing or still air tend to retard the interchange, while exposure of skin surface and air in motion and moisture facilitate the interchange. Evaporation of moisture on the skin and in the lungs also occurs. At body temperature this evaporation absorbs heat at the rate of 582 calories per liter. Loss of heat to ingested food and fluid, inspired air, and excreta, is a relatively negligible quantity that is estimated as not over 5 per cent of total heat loss.

Physiologically, advantage is taken of these physical factors to stabilize temperature. Under average conditions the heat loss by evaporation from the skin and lungs is about equal, and the loss by radiation, conduction, and convection from the skin is two to three times the amount lost by evaporation (MacLeod[7]). This loss from the skin is governed by altering the capillary blood flow and modified, of course, by degree of insulation by clothing and still air. Vasoconstriction occurs when there is need to protect the body from an unfavorable environment, usually from chill, but the same effect may occur on exposure to extreme heat. Flinn[14] observed vasoconstriction and blood concentration resulting from exposure to a temperature of 122° F. (50° C.) for one hour. Ordinarily, however, peripheral vasodilation and associated pulse acceleration occur as the initial physiological effort when there is need to dissipate heat.

Under conditions of heat accumulation due to either increased production or decreased dissipation this mechanism may be insufficient, in which case the sweat glands are stimulated to action and respond with perspiration that may or may not be visible. Visibility depends upon the degree of activity and rapidity of evaporation and is no criterion of the amount of perspiration or effectiveness of refrigeration. Under conditions of high humidity perspiration may be conspicuous and evaporation negligible, while at high altitude with low humidity perspiration may be profuse yet insensible. Associated with the alteration in the peripheral capillary bed, there is proof of alteration in the fluid content of the blood. Barbour et al.[15] have experimental proof that chill produces anhydremia with loss of fluid to the tissues, while heat[16] produces hydremia with absorption of fluid by the blood from the tissues.

Evaporation permits the body to tolerate temperatures that would otherwise be totally incompatible with life. In the absence of evapo-

[7] See footnote 7 on p. 481.
[14] Flinn: U. S. Public Health Reports, vol. 40, No. 18, 1925.
[15] Barbour et al.: Am. Jour. Physiology, vol. 73, p. 315, 1925.
[16] Am. Jour. Physiology, vol. 59, pp. 300 and 306.

ration, Haldane[17] places the upper limit of safety at 88° F. (31.1° C.), if at rest, and 78° F. (25.5° C.), if working in still atmosphere. Above these temperatures some evaporation is essential. When the environmental temperature reaches blood heat evaporation must play the sole rôle of stabilization. At a wet and dry bulb temperature of 98° F. (36.7° C.), under which condition heat interchange between the body and environment is practically at equilibrium, Haldane found the body temperature to rise at the rate of 4° F. (2.2° C.) per hour. For temperatures above body temperature, evaporation must not only compensate for the heat of metabolism, but must also neutralize heat accumulated from the environment by radiation, conduction, and convection. Hill[18] estimates water loss in man for the 24-hour period in per cent of body weight: Average in summer, 4.8 per cent; when working hard, 7.7 per cent; upper limit of safety, 10 per cent. Hunt[19] reports experiences in the Deccan where maximum temperatures were seldom under 100° F., dry bulb, and 110° F. was experienced over long periods. All members of a party living under these conditions consumed more than 3 gallons of water per day. Allowing 1,500 c. c. for loss in excreta, approximately 10 liters remain to be accounted for as lost from the lungs and skin. This would represent a heat loss of 5,820 calories if all were evaporated. The same author, using a Turkish bath, investigated water loss, at rest, upon exposure to temperature varying from 140° to 180° F. (60° to 82.2° C.), and found losses of 2 pounds per hour, approximately 900 c. c. If this were completely evaporated it would represent 524 calories, which is comparable to the heat loss when walking at the rate of 4 miles per hour. Moss[20] reports a maximum water loss of 5.5 pounds, approximately 2,500 c. c., per hour, in acclimatized miners. Doubtless, some water is lost in these extremes before complete evaporation can occur, but they illustrate well the physiological response to increased temperature.

The effectiveness of evaporation as a refrigerant is based upon the well-known law of latent heat. Water in passing from a liquid to a gaseous state absorbs 582 calories per kilo, at body temperature, that is, 5.82 times as much heat as is required to raise it from freezing to boiling temperature. Also every rise of 27° F. (15° C.), in temperature approximately doubles the water vapor capacity of the air. The latter factor is particularly important, because evaporation is directly dependent upon the capacity of the air to take up water, that is, upon the relative humidity. Determination of the percentage of water saturation of the air therefore is of importance

[17] Haldane: Jour. of Hygiene, 5: 494, 1905.
[18] Hill: Recent Advances in Physiology and Biology.
[19] Hunt: Jr. of Hygiene, vol. 12. 1912.
[20] Moss: Brit. Med. Jr., 1: 986, 1923.

in evaluating the effect of all temperatures upon the organisms, and for temperatures above 88° F. becomes of vital significance. The wet bulb thermometer has been devised to measure the degree of water vapor saturation of the air. Obviously, dry air facilitates rapid evaporation and cools the thermometer or any moist surface. As the air approaches saturation the wet bulb readings approach dry bulb readings and evaporation is correspondingly retarded. This is a static reading, measuring a given state at a given time. Hill [21] has devised the spirit Kata thermometer to determine dynamic or progressive cooling power under conditions simulating those present at the skin surface and calibrated to measure rate of heat loss in terms of microcalories per square centimeter of surface. Used as a dry bulb it measures rate of heat loss by conduction, convection, and radiation. Used as a wet bulb, it, in addition, measures the rate of heat loss by evaporation.

The degree of air stagnation on the body surface is another important physical factor that must be considered. It is modified by rapidity of air movement and clothing. In general, increased air movement promotes equalization of temperature between the body and the air. It either accelerates cooling or heating the skin, depending on whether its temperature is above or below that of the body. If the air is not saturated with water vapor, air movement, in addition, promotes evaporation regardless of its temperature; however rapid flow of hot dry air may cause more discomfort from drying and heating than comfort from promoting evaporation. Comfort is therefore dependent upon a favorable balance of the factors—air temperature, air humidity, degree of air stagnation as modified by clothing and air flow, and physiological response, all of which represent fluctuating variables. Yaglolou [22] graphically shows the physical factors in a thermometric chart with comfort zone superimposed. Hearne, quoted by Willcox[23], observed that patients in a Mesopotamian hospital who were suffering from heat stroke with suppression of perspiration objected to the draft from electric fans. Other patients were more comfortable when the fans were in motion.

Haldane [17] found that while 88° F. (31.1° C.) was the limit in still saturated air, if air movement occurred at the rate of 170 linear feet per minute a temperature of 93.9° F. (34.4° C.) was the upper limit at which heat accumulation did not occur. These are the basic physical factors involved in the problem of adjustment and maladjustment to variable temperature. Maintenance of normal temperature under conditions favoring heat accumulation is therefore a

[17] See footnote 17 on p. 486.
[21] Hill et al.: Phil. Trans. Royal Soc., London, Series B, 207: 183, 1916.
[22] Yaglolou: Jour. Am. Soc. Heat Vent. Engineers, May, 1927, p. 296.
[23] Willcox: Brit. Med. Journ., 1: 392, 1920.

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problem of evaporation, and evaporation in turn is dependent upon an atmosphere permitting evaporation and the physiological production of sufficient perspiration.

Much experimental knowledge has accumulated relative to the physiological response to heat. Only that which seems pertinent to the mechanism of heat stroke can be reviewed here. It is known that when the environmental temperature rises above 86° F. (30° C.), (Winternitz [3]) metabolism accelerates, due to an active physiological effort to promote dissipation with a corresponding heat production. As a result, a potential vicious cycle is initiated, heat being produced in the physiological process of eliminating heat. Increased perspiration is the normal response and equilibrium is maintained through increased cooling from evaporation. Attention has already been called to the remarkable extent to which the body can respond with water loss. This ability to perspire freely is better developed in man than in any other organism, and results in greater toleration of excessive temperatures. The source and supply of this water are of first importance in the physiology of heat regulation. Based upon the blood volume calculations of Keith, Rountree, and Geraghty,[24] there are 89.1 c. c. of blood per kilo of body weight. The loss of one liter of fluid in a person weighing 150 pounds represents approximately 16.5 per cent of the total blood volume and 33 per cent of the total plasma volume. Such marked fluid loss can be only transitory in the blood, and the major fluid depletion must occur in some other tissue. Engles [25] investigated the source of this fluid in experiments on dogs and determined that 85 per cent of it comes from muscles (67.89 per cent) and skin (17.75 per cent).

The reserve supply of fluid in the tissue is considerable, but limited, and when this supply is depleted perspiration ceases and heat loss can occur only by conduction, radiation, and convection. Such a body reacts to environmental temperature as if the air were completely saturated. Hunt [19] experimentally confirmed the clinical observation that such a depleted body has only a limited tolerance for water, that replacement of the excessive loss occurs slowly (16 hours in his experiment), and that free intake after extensive drain results in needless profusion of perspiration and may be harmful. The saline content of the perspiration is of interest. Hunt [19] states that it is approximately 0.21 per cent, and Moss [20] calculated it to be 0.2 per cent. Each liter of perspiration would represent a loss of 2 grams, or 6.5 per cent, of the salt content of the whole blood of a 150-pound man.

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[3] See footnote 3 on p. 480.
[19] See footnote 19 on p. 486.
[20] See footnote 20 on p. 486.
[24] Keith, Rountree, and Geraghty: Arch. Int. Med., 16: 547, 1915.
[25] Engles: Arch. f. exper. Path. u. Pharmakol. Leipz., 1904, 51: 346.

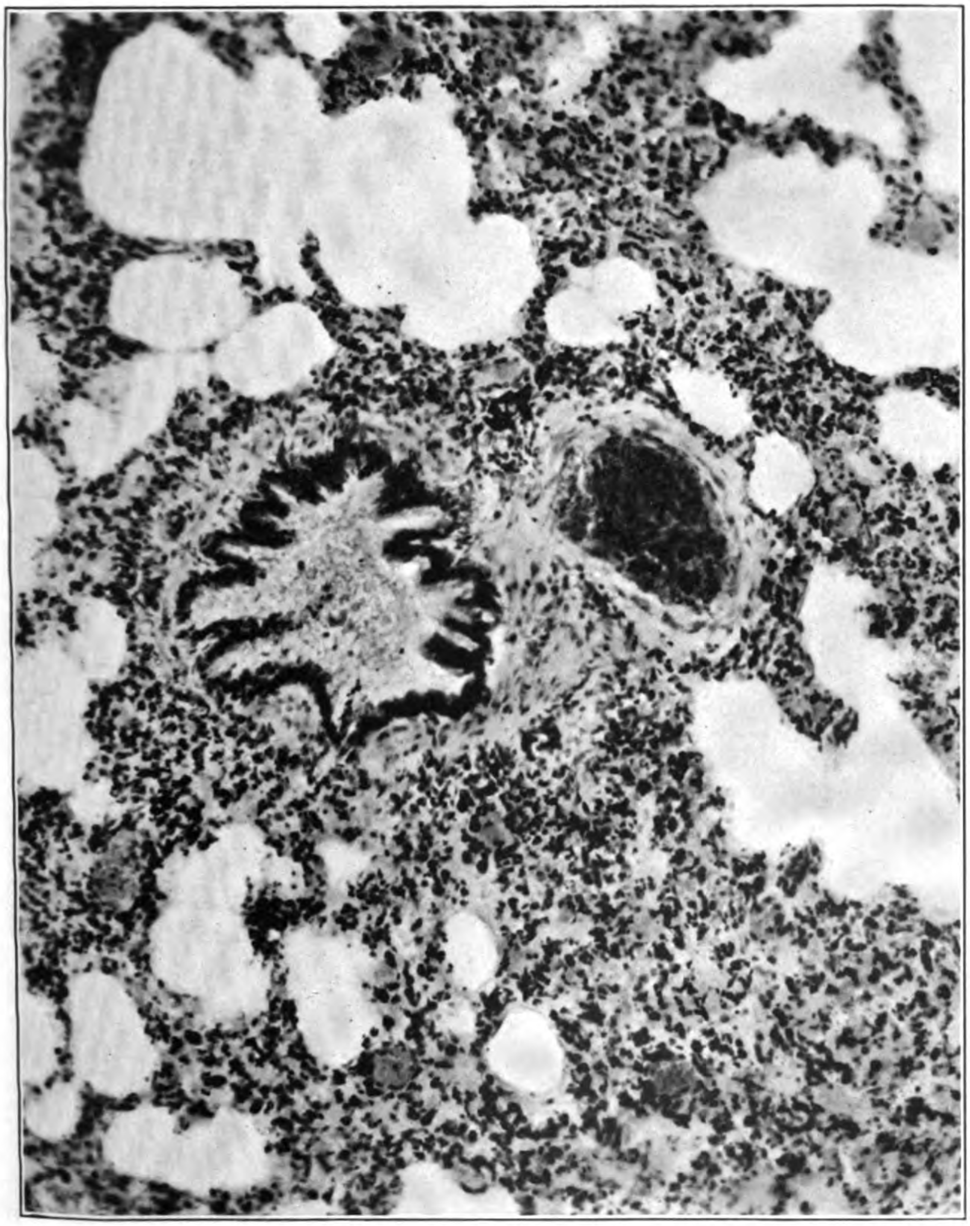

Fig. 1.—Shows type of pulmonary lesion. Magnification X240 on 7 by 9 inch negative

488—1

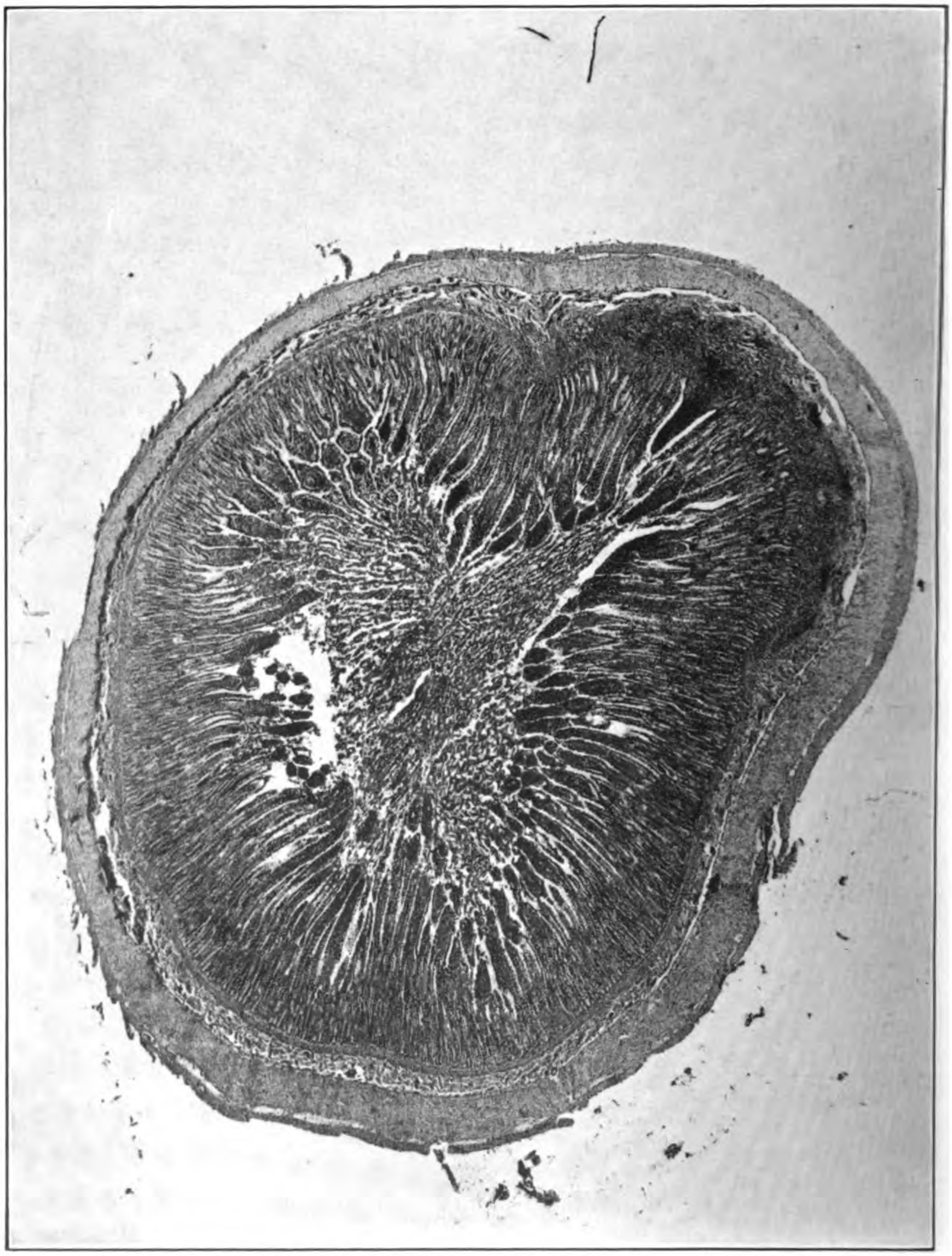

Fig. 2.—Low power cross section of colon, showing contraction. Diameter of mounted section, 7.0 mm.

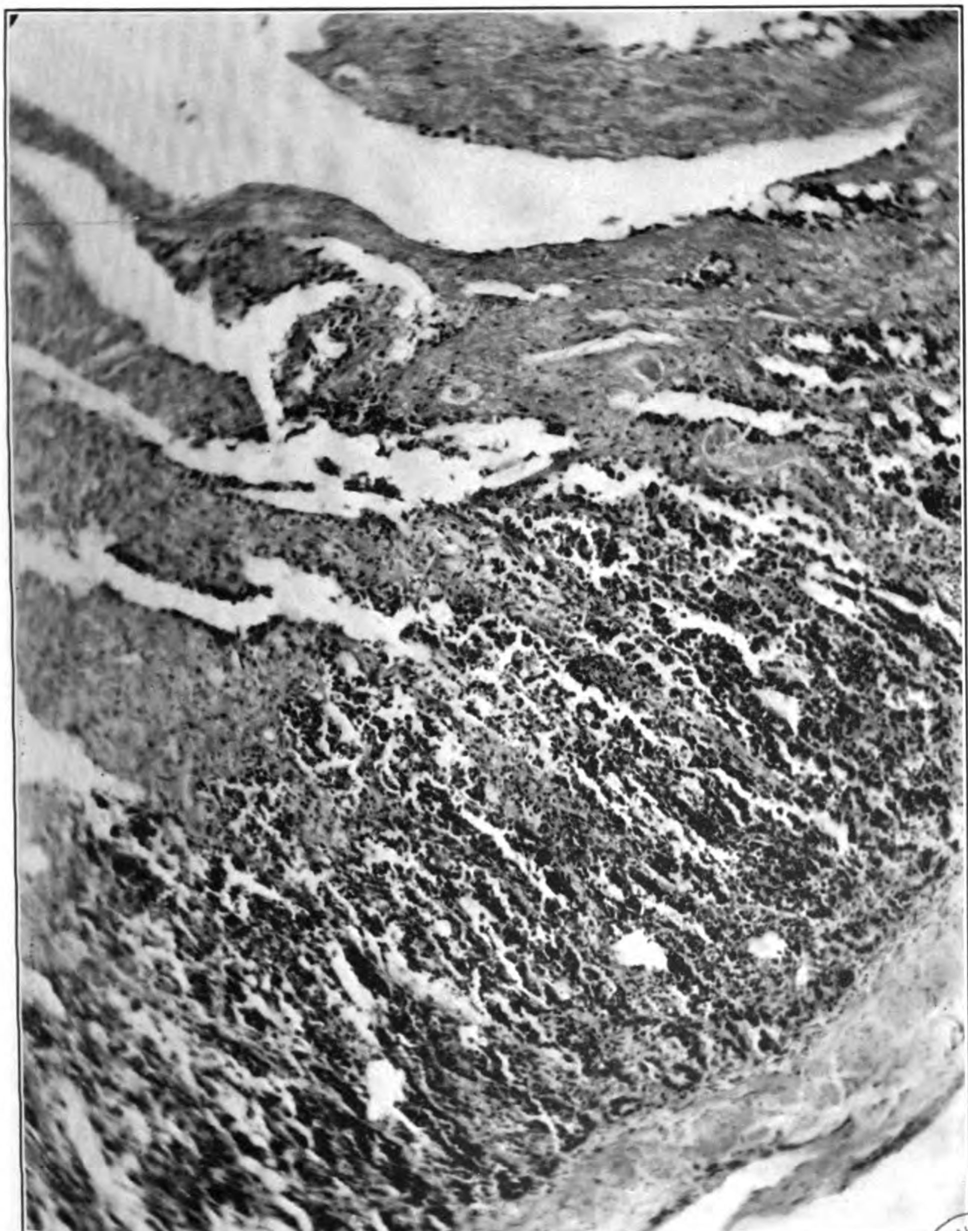

Fig. 3.—Shows alteration in intestinal mucosa under higher magnification

488—3

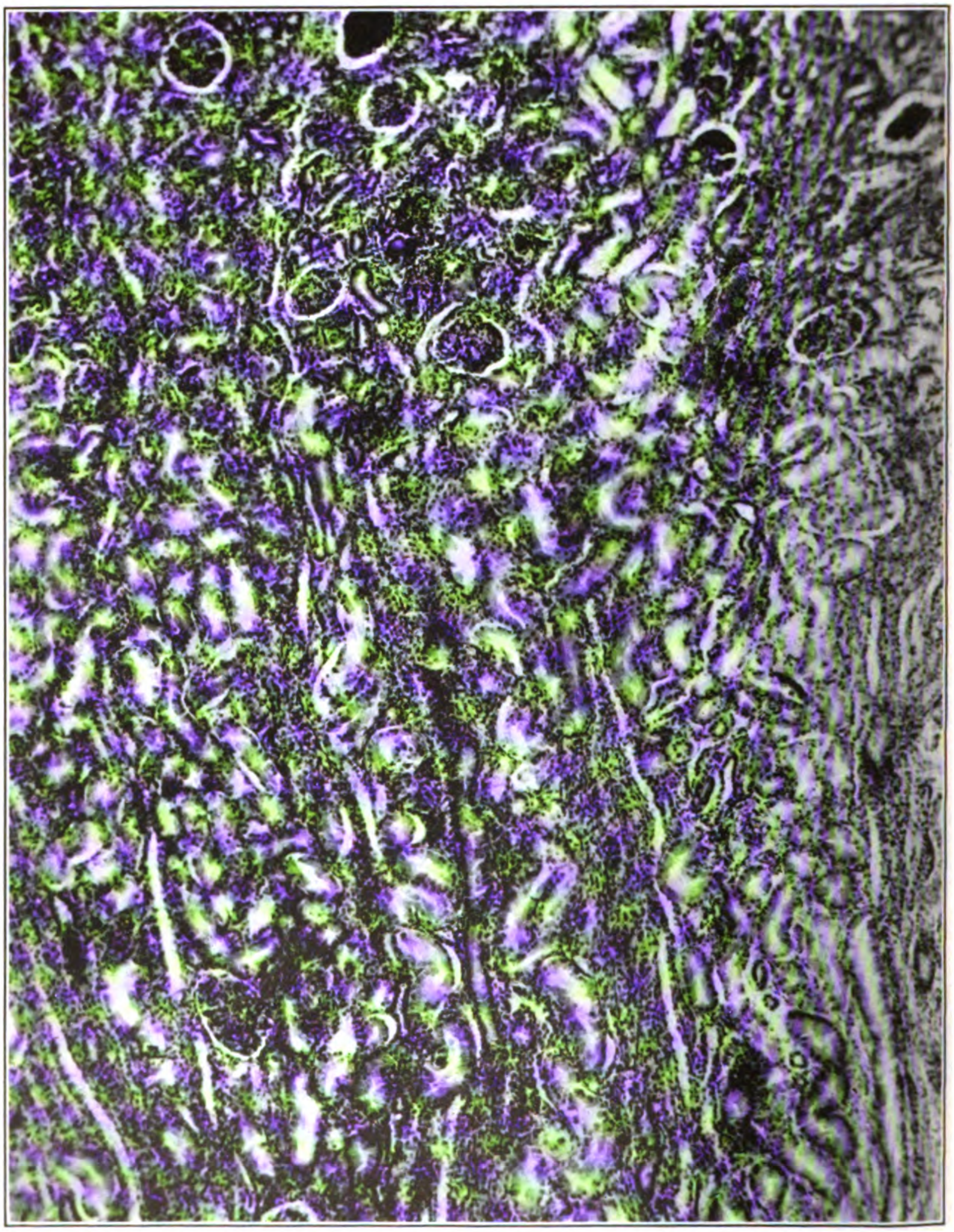

Fig. 4.—Shows changes noted in the kidney. (X120)

488—4

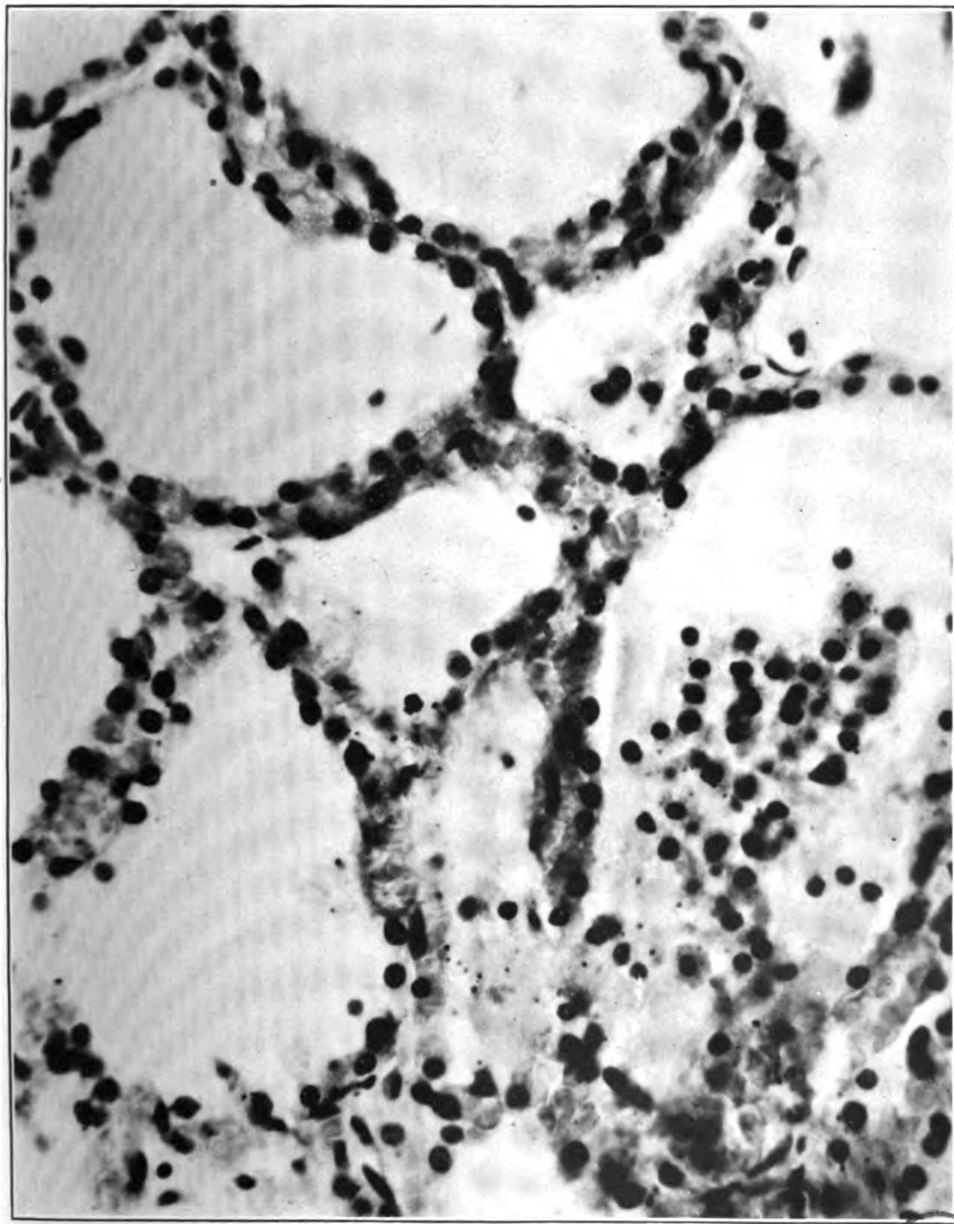

Fig. 5.—Type of thyroid lesion found in animal that died five minutes after completion of exposure. Depletion of colloid and parenchymatous degeneration are marked. (X360)

488—5

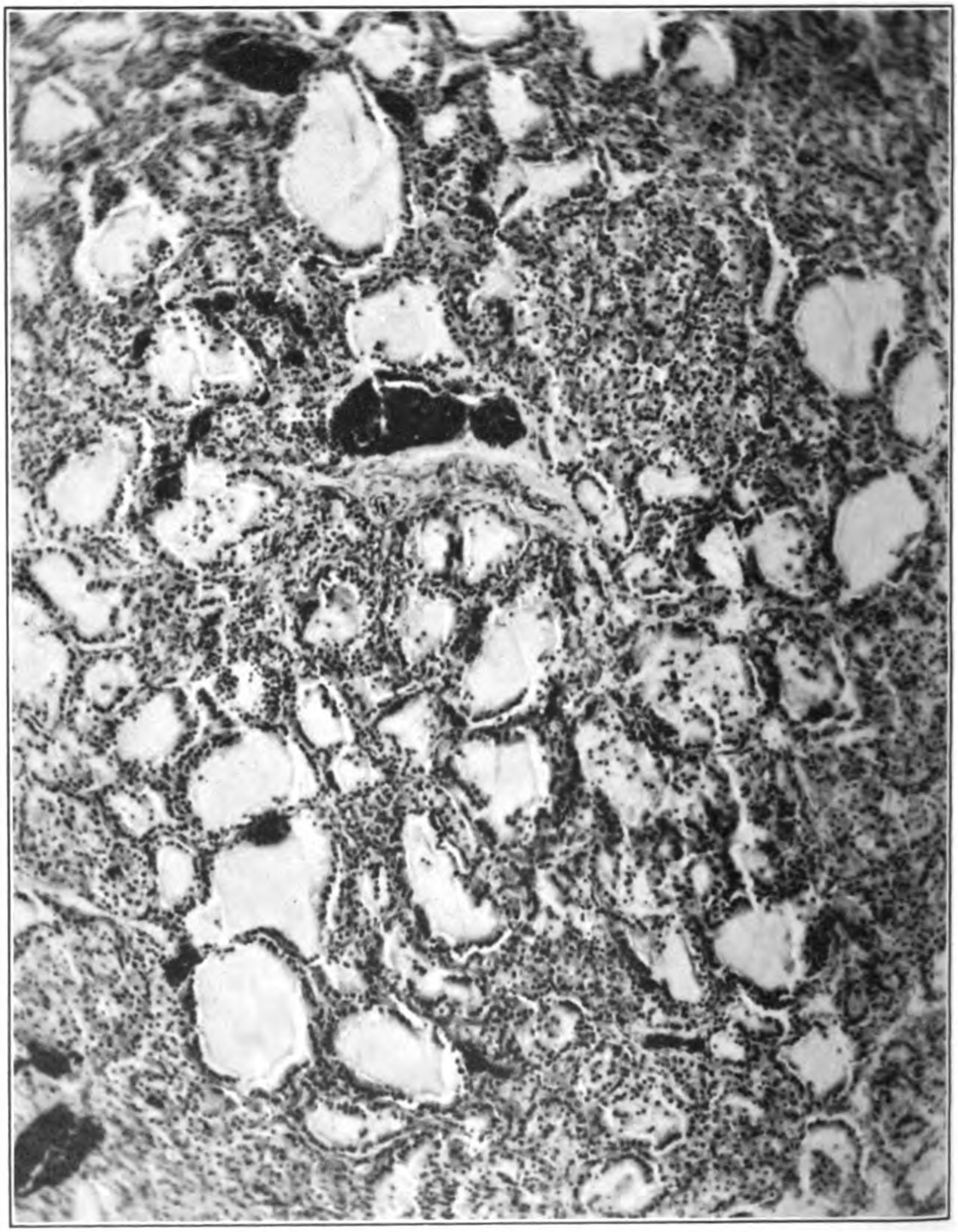

Fig. 6.—Thyroid of animal that survived for 12 hours after exposure. **Colloid depletion is** marked. Epithelial proliferation is apparent. (X195)

488—6

Physiological response of man to tropical and experimental environments of high temperature has been investigated. Hunt [19] reports that under tropical conditions, midday "shade" temperatures of 110° F. (43.3° C.), dry bulb, healthy persons experienced no great discomfort and fairly hard physical work was possible in the sun. He makes the interesting comment that he "has come across no case as yet of pure heat stroke or sunstroke in a proved healthy individual," and "such a life is led by hundreds of Europeans and usually with a gain rather than a loss to health." Attacks are attributed by him to insufficient water intake or associated incidental pathological processes sufficient to disturb the normal thermoregulatory mechanism.

Young, Breinl, Harris, and Osborne [26] observed the effect of exercise and humid heat upon the pulse rate, blood pressure, body temperature, and blood concentration under tropical and experimental conditions. Observations were made during the summer months, dry bulb 80° to 90° F. (26.6° to 32.2° C.), wet bulb 75° to 80° F. (23.8° to 26.6° C.), climatic conditions approximating that of Calcutta. Pulse increment was roughly proportional to intensity of exercise; walking two hours resulted in an average increase from 90 to 150, the rate approximating 130 at the end of the first 30 minutes, and 140 at the end of the first hour. Recovery was more prompt after short periods of exercise. Blood pressure was affected more by strenuous exercise of short duration than by less stenuous exercise of longer duration. In both cases the response was prompt and rapid. Walking for two hours gave a maximum at approximately the end of 30 minutes with a distinct fall, but not to normal, during the following 1½ hours. Temperature was affected little by exercise of brief duration, elevation of 1° F. (0.55° C.) being exceptional. Prolonged exercise, even the less vigorous, resulted in greater elevation. In the two-hour walk increments of 2° to 3° F. (1.11° to 1.65° C.) resulted, the major portion being attained in the first hour. Blood concentration as determined by calculating total solids and by refractive index determination was observed. Walking 3½ hours (dry bulb, 85.2° F., 29.5° C; wet bulb, 75.3° F., 24.0° C.) resulted in a loss of weight of 2,730 grams and a water loss of the blood of 9.5 per cent. Experimental observations were made by placing subject in a galvanized chamber exposed to the sun. Humidity was increased by boiling water, and wet bulb readings as high as 102° F. (38.8° C.) were obtained. Under this condition the body temperature rose gradually and steadily, and the pulse rise was proportional. Blood pressure readings were inconsistent. Water loss averaged 500 to 1,200 grams per hour, and

[19] See footnote 19 on p. 486.

[26] Young, Breinl, Harris, and Osborne: Proc. Royal Soc. of London, Series B, Vol. XCI, p. III.

water loss of blood varied from 4.2 to 9.5 per cent. This reaction, like exercise, throws a stress upon the cardiovascular mechanism, as is manifested in the response to such treatment as hot packs, hot baths, sweat room exposure, and cabinets in which temperatures of 140° to 165° F. (60° to 73.8° C.) are employed.

Hill and Flack[27] investigated the influence of hot baths on pulse, temperature, breathing volume, and alveolar tensions of man. Their method consisted of immersing the body up to the neck in baths of 105° to 110° F. (40.5° to 43.3° C.) for intervals of 15 to 30 minutes. Body temperatures of 102.5° to 104.6° F. (39.1° to 40.3° C.) resulted. Pulse rate was accelerated as high as 160. Systolic blood pressure fell as low as 60. Loss of vasomotor tone and stability were also evidenced by excessive acceleration of pulse rate on standing, as much as 56 beats difference resulting, associated with fainting symptoms. Greatly increased respiratory rate and volume occurred and resulted in a fall of alveolar $CO_2$ tension, down to 3.07 per cent, and a corresponding rise in $O_2$ tension so that subject on removal from bath could hold his breath 2½ times as long as normal.

Bladgen and Forsythe[28] report exposure to dry air temperatures as high as 262° F. (127.7° C.) for 15 minutes without ill effect. This temperature was sufficient to cook a steak in 13 minutes. Two jars of water were placed in the hot room, one being covered with oil. In the former, evaporation was sufficient to prevent boiling. The other boiled. Living tissue will temporarily tolerate much higher temperatures and at times such extreme degrees of heat are employed therapeutically. Gas and electric bakers used in physiotherapy departments attain temperatures of 200° to 400° F. (94° to 205° C.) or more, and the usual treatment lasts 30 minutes. The physiological response corresponds with that of other forms of heat exposure. Function is accelerated in an effort to keep tissue temperature within physiological limits. Brown, et al.,[29] experimentally applied diathermy to the chest of dogs. Currents sufficient in strength to almost produce local burns were used. This heat was so well dissipated that temperature within the chest, between the electrodes, increased only about 2.7° F. (1.5° C.) and the rectal temperature remained essentially unchanged.

The mental reaction to hyperthermia is described by Sutton.[30] Wet bulb readings approximately 96° F. (35° C.) were obtained in a ventilated room. The initial sensation on entering the room was a marked sensation of warmth, but with onset of perspiration this was replaced by a general relaxation and marked degree of sleepiness lasting about one-half hour. Then the temperature began to

[27] Hill and Flack: Proc. Physiolog. Soc., Mar. 27, 1909; Jr. of Phys., vol. 38.
[28] Bladgen and Forsythe: Phil. Trans. of the Royal Society, London, 13; 1775.
[29] Brown et al.: J. A. M. A., 89: 875, 1927.
[30] Sutton: Jour. Path. and Bact., 13: 62, 1909.

rise, due to broken thermoregulatory compensation. At 99.5° F. (37.5° C.) rectal, there was a sudden and definite change to wakefulness, irritability, and restlessness. At 103° F. (39.1° C.) this was exaggerated and any irritation, however slight, became actually annoying. From 106° to 108° F. (41.1° to 42.2° C.) coma, delirium, and convulsions are observed clinically, and as temperature rises complete unconsciousness develops.

The physiological response of the skin to local insolation has been investigated by Aron.[31] The average usual skin temperature was determined to be 90.5° to 92.3° F. (32.5° to 33.5° C.). Skin exposed to the sun rapidly increased in temperature to 96.8° F. (36° C.), or a maximum of 98.6° F. (37° C.), when perspiration began and skin temperature fell. He found that brown skin absorbed more heat than white and responded more promptly with perspiration and consequent cooling. Daubler, quoted by Aron,[31] states that the Negro has larger and better developed sweat glands than the white man. The skin and subcutaneous tissue tolerate temperatures that are fatal to the organism as a whole. Corbus and O'Connor[32] state that normal nourished epithelial cells survive exposure to a temperature of 118° F. (47.8° C.) for an hour, and that connective tissue cells will tolerate even higher temperature for a longer period.

The field of animal experimentation furnishes considerable material of significant value. Lozinsky[33] observed the effect of heat experimentally (upon dogs) under conditions of high and low humidity. When the humidity varied from 80 to 94 per cent panting developed at 86° F. (30° C.), and above 92° F. (33° C.) body temperature became poikilothermic, rising almost degree for degree. One dog survived a temperature of 105° F. (40.1° C.) at the end of the hour. Another died one-half hour after an hour's exposure to 106° F. (41° C.), body temperature reaching 111° F. (43.8° C.). Under conditions of low humidity of 21 to 51 per cent higher temperatures were tolerated. No significant change was noted for temperatures below 101.8° F. (38.8° C.); above 107.6° F. (42° C.) they observed vigorous panting, rise in body temperature and blood concentration. One dog survived a temperature of 122° F. (50° C.) for an hour, its body temperature rising to 111° F. (43.8° C.) and returning to normal within an hour. Another survived a temperature of 130° F. (54.5° C.), body temperature rising to only 104° F. (39.7° C.) and returning to normal within an hour.

Hall and Wakefield[34] subjected dogs to temperatures ranging from 130° to 140° F. (54.5° to 60° C.) under high humidity. No dog survived exposure exceeding 36 minutes in length and 36 minutes and

[31] Aron: Philippine Jour. Sc., 6: 101, 1911.
[32] Corbus and O'Connor: J. A. M. A., 87: 1816, 1926.
[33] Lozinsky: Am. Jour. Phys., vol. 67: 388, No. 2.
[34] Hall and Wakefield: J. A. M. A., 89: 177, 1927.

less exposure were usually but not uniformly fatal. Britton[35] observed the effect of increased temperature upon fish. At 77° F. (25° C.) some restlessness was observed and death soon followed exposure to 86° F. (30° C.). Aron[31] reports on the action of direct tropical sun rays on monkeys. When the entire body was exposed the animal died after 70 to 80 minutes exposure, the body temperature rising to 107.6° F. (42° C.) or above, and subcutaneous temperature reaching as high as 114° F. (46° C.). When only the head was exposed, the body being protected, one animal survived a total exposure of 54 hours in 12 days. Its body temperature remained normal and readings as high as 116.6° F. (47° C.) were obtained in the hair of the scalp. There is clinical confirmation of the brain's tolerance of local application of heat. Horsley advocated the use of hot-water irrigation of 110° to 115° F. (43.3° to 46.1° C.) to the brain to control capillary hemorrhage, but advised against a temperature of 120° F. (48.8° C.). Incidentally, it is of interest that Willcox reports that Horsley died from heat stroke in Mesopotamia.

Typical examples of conditions under which heat stroke develops are of interest. Willcox[28] records three years' experience under tropical conditions in Mesopotamia. During the month of July, 1917, shade temperature reached 120° F. (48.8° C.) or more, on 6 days and reached or exceeded 115° F. (46.1° C.) on 15 days. Corresponding tent temperatures for this period were 130° to 140° F. (54.4° to 60° C.). He reports a shade temperature of 110° F. (43.3° C.) as dangerous, and 120° F. (48.8° C.) as exceedingly dangerous, resulting in morbidity and mortality.

From Chicago, Gauss and Meyer[36] report a series of 158 cases of heat stroke and heat exhaustion, 147 of which occurred between July 26 and July 31, 1916. During this interval the temperature was continuously above 82° F. (27.7° C.), and attained a maximum of 101° F. (38.3° C.). Relative humidity averaged 58. Mortality for the entire group averaged 44.3 per cent. Of these, 11 had an admission temperature of 98° F. (36.6° C.), or less, with a mortality of 3, or 27 per cent. The admission temperature of 107 ranged from 99° to 109° F. (37.2° to 42.7° C.), with a mortality of 32, or 30 per cent. Of these, 19 had a temperature of 109° F. (42.7° C.), with a mortality of 5, or 26 per cent. Of 38 admitted with a temperature of 110° F. (43.3° C.) or above, 31, or 81.5 per cent, died. Their lowest recorded temperature was 94° F. (34.4° C.), and the maximum was 114° F. (45.5° C.). The highest recorded temperature found in the literature is reported by Lambert[37] as 117.8° F. (47.6° C.), resulting from sunstroke.

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[28] See footnote 28 on p. 487.
[31] See footnote 31 on p. 491.
[35] Britton: Am. Journ. Phys., 67: 411, No. 2.
[36] Gauss and Meyer: Am. Jour. of Med. Sc., 154: 554, 1917.
[37] Lambert: Handb. of Med. Sc., 5: 124, 1923.

 

The naval service furnishes several reports of interest. Phelps [38] reviews the occurrence of heat cramps and heat exhaustion in the fleet. During 24-hour trials one vessel had fireroom temperatures of 136° to 140° F. (57.7° to 60° C.), and no man felt any ill effects. Another vessel reported 56 cases in 7 days. Of these, 7 occurred in the first three days, with an average fireroom temperature of 112° F. (44.4° C.). The remainder occurred with an average fireroom temperature of 125° F. (51.6° C.), maximum 131° F. (55° C.). Cramps were common and exhaustion exceptional. Analysis of these statistics would suggest that heat precipitated attacks in cases physically below par from stress of duty, prolonged exposure to high temperature, or inexperience. The Bureau of Construction and Repair furnishes information on record high temperatures. One vessel is reported to have had a temperature of 150° F. (65.5° C.) in the boiler room; wet-bulb reading not known. Another vessel, a battleship, is credited with maximum temperatures of 130° F. (54.5° C.), dry bulb, and 110° F. (43.3° C.), wet bulb, in one engine room. Such temperatures are obviously incompatible with thermoregulatory compensation, and the record for 1925 charges this particular vessel with 82 cases of heat stroke, more than 50 per cent of the admissions of the entire fleet and train for that year. In describing cramps, Elliott [39] states that these attacks are always preceded by profuse sweating, "the skin actually seems to be leaking and towards the latter end of the attack the face becomes shrunken and the patient presents the appearance of one sick from cholera, which it much resembles in the cramps of the muscles."

Cramps merit special consideration. Classification of cramps as a separate entity is questionable. They are certainly one of the manifestations of heat stroke. Experiences in the Navy and in mines would seem to justify accepting cramps as one type of incompetency. Willcox [23] fails to make this distinction from tropical experience, but notes that they may occur in the choleraic type of heat stroke. Moss [20] attributes miners' cramps to great heat, loss of chlorides by sweating. excessive drinking water, and temporary paralysis of renal secretion. Therapeutically it is of interest to note that in 1908 Elliott [39] treated these cases with saline enemas and reports that patients in a state of complete collapse would be out of danger in one-half hour.

The clinical manifestations of cramps vary from fibrillary contractions to a tetany so severe that one author has attributed the etiology to tetanus infection in the intestinal tract. The condition may resemble the tetany of parathyroid calcium deficiency so closely

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[20] See footnote 20 on p. 486.

[23] See footnote 23 on p. 487.

[38] Phelps: U. S. Nav. Med. Bull., 24: 145, 1926.

[39] Elliott: Mil. Surg., 22: 227, 1908.

that the clinical manifestations appear identical. In heat cramps, however, there is a differential feature in that the neurological findings are said to be normal. Some parathyroid trauma may be presumed to occur along with the general parenchymatous damage, but has not been demonstrated. Hall and Wakefield [34] found essentially normal blood calcium findings in heat exhaustion. However, it is not known what portion of this is ionized and available for use. A conspicuous feature of heat stroke, particularly the exhaustive and cramp types, is water and salt loss. The profuse perspiration is not infrequently supplemented by diarrhea and emesis. The clinical observation has been made by Dickens [40] that when the blood chlorides fall to approximately 300 milligrams per 100 c. c., tetany and coma develop. Willcox [23] classifies one type of heat stroke as choleraic. The muscles contribute approximately 68 per cent of this fluid and salt loss, and may be presumed to suffer correspondingly. Usually, water only is ingested to replace this loss, and is often taken in excess because it does not entirely satisfy the thirst. Salt is also required. Woodyatt [41] dehydrated animals by large doses of glucose solution given intravenously. Definite rigors and temperatures as high as 108° F. (42.2° C.) resulted. Replacement of fluid relieved these symptoms.

Accumulation or production of various substances within the muscle cells have long been suspected of causing tetany. Concentration of lactic acid formed in the muscle from glycogen roughly approximates the extent of muscle shortening according to Myerhoff and Himwick.[42] Howell [43] gives the following figures for lactic acid concentration in muscle: At rest, 0.02 to 0.03 per cent; during contraction, after fatigue, 0.4 to 0.5 per cent; in processes leading to rigor, 0.5 to 0.6 per cent. Hall and Wakefield [34] noted increases of lactic acid in the blood in experimental heat exhaustion approximating 300 per cent. They report symptons suggestive of cramps in one animal, and evidence of tetany was noted in the heart and intestines. The highest concentration of lactic acid found in the blood of any of these animals was only 0.194 per cent. If lactic acid is the cause of this tetany it becomes necessary to presume that it accumulates in much higher concentration in muscles than in the blood.

Guanidine, a nucleus in creatine, present in muscle and closely related to urea, has been proposed as the cause of tetany by Paton,

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[23] See footnote 23 on p. 487.

[34] See footnote 34 on p. 491.

[40] Dickens: Liver Function Tests (to be published).

[41] Woodyatt: Studies on Intermediate Carbohydrate Metabolism. Harvey Lectures, 1915–16.

[42] Myerhoff and Himwick: Pfluger's Archiv., 205: 415, 1924.

[43] Howell: Textbook of Physiology, 10th ed., p. 64.

et al.,[44] and Collip[45] found that an injection of this substance will produce tetany when there is no calcium deficit.

Coagulation of muscle proteins by heat has also been suggested. This hypothesis seems untenable. Cramps usually occur with normal or subnormal temperature. According to Howell,[43] muscle contains two proteins, myosin, coagulating at 111.2° to 122° F. (44° to 50° C.), ad myogen, coagulating at 131° to 149° F. (85° to 65° C.).

Tetany in heat stroke and allied conditions has been attributed to an alkalosis. In support of this hypothesis, in heat stroke there is increased respiratory rate, increased pulmonary ventilation, and decreased alveolar $CO_2$ tension. However, blood chemistry findings indicate an uncompensated acidosis on the basis of decreased $CO_2$ combining power and a fall in the $_pH$, (increased acidity). These apparently inconsistent findings can be attributed to a severe pulmonary lesion that embarrasses respiratory exchange.

The biochemical alterations associated with the various types of heat stroke in general are still largely undetermined and many reports suggest hypothetical or conflicting opinions. Among the hypotheses proposed to explain the action of heat is autointoxication, a general term probably sufficiently broad to include the actual factor but certainly too indefinite to be of much value. It is proposed by Elliott and Willcox among others. Mayer,[46] from experimental work on coral, attributes the disturbance to accumulation of an undetermined type of acid resulting from accelerated metabolism. He suggests lactic acid and $H_2CO_3$ as possibilities. Hall and Wakefield,[34] in their heat exhaustion experiments on dogs, noted marked fall in alkali reserve, decreased $_pH$ (increased acidity), of the blood, and found that the lactic acid content of the blood was increased on an average of 300 per cent. Their analyses show a moderate but consistent increase in the nitrogenous elements of the blood, attributed to protein destruction and accelerated metabolism rather than to retention. Creatinine was least affected. One dog, however, that survived had at the end of two weeks the highest degree of azotemia noted. This would seem to be due rather to retention resulting from marked renal trauma. They attribute the acidosis and acute pathological changes in heat stroke to a massive increase in lactic acid. Their findings, however, leave the problem unsettled. The maximum concentration of lactic acid they found in the blood represents less than half that noted in fatigued muscle and less than one-third that found

[34] See footnote 34 on p. 491.
[43] See footnote 43 on p. 494.
[44] Paton et al.: Quart. Jour. Exp. Physiol., 10: 203 238, 243, 315, 377, 1916.
[45] Collip: J. Biol. Chem., 67: 679–687, 1926.
[46] Mayer: Am. Jr. Physiol., 44: 581, 1917.

in a muscle in rigor. No determinations were made on the lactic acid concentration in the tissues, but it may be presumed to have been considerably higher than that of the blood because these animals gave symptoms of tetany. The profound pulmonary lesions induced in these animals are certainly sufficient to embarrass seriously respiratory exchange with some resultant anoxemia, faulty oxidation, and retention of carbon dioxide. It is believed that this disturbed respiratory exchange is the actual common cause of the accumulation of lactic acid through failure of oxidative synthesis into glycogen and of the acidosis through the accumulation of this and perhaps other acid bodies, resulting from the anoxemia, and the faulty elimination of carbonic acid.

Cell coagulation, particularly of the nerve cell, has its advocates. Fahraeus [47] observed sudden changes in cells occurring at temperatures just above normal. He noted that lipoids lost their characteristic anisotropy. Halliburton and Mott [48] observed well-marked changes in Nissl's granules at a temperature of 107.6° F. (42° C.), and that if this temperature persisted for some time coagulation of the nerve cell occurred. Rogers [49] states that the average duration of unconsciousness of patients prior to admission and institution of adequate therapy was 210 minutes in fatal cases and 80 minutes in cases that recovered. Goldschneider and Flatau [50] observed structural changes in the anterior horn cells in animals heated to 107.6° to 111.2° F. (42° to 44° C.). Their experiments would indicate that this alteration is due to some physiochemical reaction and not directly due to heat, because when these tissues were heated post mortem, to temperatures as high as 112.3° F. (44.6° C.), these changes did not occur. They noted that recovery of function in these animals occurred more rapidly than did restitution of normal cell structure. These authors and Barker [51] warn investigators that it is unwise to judge functional disturbance by structural alteration of nerve cells resulting from acute poisoning. Lambert [37] states that death is not due to failure of the nerve fibre to conduct impulses, as they do not lose this function until they are heated to a temperature of 125.6° F. (52°C. ).

The cause of death in heat stroke merits comment. Fatal outcome may occur with almost lightning-like rapidity with little or no prodromal warning. However, these cases seem to be precipitated usually in tense situations where attention is diverted from body function. This death, like that frequently from coronary disease,

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[37] See footnote 37 on p. 492.
[47] Fahraeus: Acta. Path. et Microbiol. Copenhagen, 2: 289, 1925.
[48] Halliburton and Mott: Arch. of Neurology, 2: 727, 1903.
[49] Rogers: Fevers in the Tropics, p. 295, 1908.
[50] Goldschneider and Flatau: Forsch. Med., p. 609, 1897.
[51] Barker: The Nervous System, p. 286, 1901.

has been attributed to cerebral trauma. This fallacy should have been interred with its originator before it became so indelibly incorporated and copied in medical literature. The immediate cause of death in these cases seems obvious from clinical and autopsy findings, yet no record has been found in which these findings have been correctly interpreted. Heat stroke tends to produce muscle tetany. This affects plain and cardiac as well as voluntary muscle. Repeatedly, extreme tetany of the heart has been noted post mortem. Physiologically, pulmonary congestion predominating over liver congestion adds weight to the hypothesis that the heart in heat stroke suffers from tetany as does other muscle and may pass into a state of rigid contraction which is the immediate cause of death that occurs suddenly. Fatal cases that escape this tetany hazard die from a variety of causes, the cause in any particular case depending upon a generalized physiological disorganization and inherent weakness in the individual.

Critical analysis of statistics would indicate that, generally speaking, a case of heat stroke receiving prompt attention and adequate treatment should recover if the patient is in good physical condition and the temperature does not exceed 109° F. (42.7° C.). Death occurring at body temperatures of 109° F. or less would seem to be due to prolonged exhaustive exposure, inadequate therapy, or some physical defect. For temperatures of 110° F. (43.3° C.) and above, death is the rule, although recovery is not uncommon in robust patients promptly treated. Lambert[36] reports a case with a temperature of 115° F. (46.1° C.) that recovered. Death in these cases can not be attributed to any single organ or function. The physiological disorganization is generalized, the various organs and tissues are reciprocally disturbed, and a vicious metabolic cycle develops. Death follows from a terminal cardiovascular failure, respiratory complications, or renal retention. Alcoholism, organic disease, and other debilitating factors such as infection, senility, excessive fatigue, and operative procedures are important contributory causes in increasing morbidity and mortality.

The biochemical phenomena associated with heat stroke are of more than academic interest in the general field of medicine and surgery. Hyperpyrexia, coma, and tetany are not uncommon observations in patients not subjected to heat exposure. Such cases represent heat accumulation from thermoregulatory disturbance. Hyperthermia unrelated to infection is an occasional observation as a postoperative complication. Such cases may run a course that is clinically and pathologically typical of heat stroke. Manifestations of thermoregulatory incompetency are particularly prone to occur following operation on the hepatic system. The patient may

[36] See footnote 36 on p. 492.

pass either into a state of vasomotor collapse resembling that noted in heat exhaustion or develop hyperthermia, coma, and tetany. Like heat stroke the cause of this disturbance is not known, although it seems to be definitely related to a loss of water, salt, and sugar from the blood. Also, like heat stroke, the condition responds to essentially the same therapeusis.

Reports of gross and histopathological findings in heat stroke are conspicuous for their brevity. The pathology is discussed in general terms in the literature, and the complete necrospy protocol is exceedingly rare for a disease not uncommon and having a substantial mortality.

Various authors, including Bernard [52], Wood [53], Sefftleben [54], Elliott [39], Fayrer [55], McKenzie and Le Count [56], Willcox [22], Simpson [57], Lambert [37], Fabris [58], and Haberda [59], agree essentially on the pathological findings in heat stroke. Rigor mortis sets in early and post-mortem elevation of temperature may occur. Decomposition begins promptly and is accelerated. Generalized vascular congestion is marked. In sunstroke the meninges may be especially involved. Edema and petechial hemorrhages have been frequently observed in the skin, viscera, brain, and elsewhere. The blood is quite dark, even black, fluid or poorly clotted, and of acid reaction. Marked contraction of the left ventricle, described as woodeny hardness, has been a common finding. Elliott [39] reports this tetany in a fatal case of cramps that had a temperature of 97° F. (36.1° C.). This tetany does not persist, and a flaccid heart is noted a few hours after death. Congestion, edema, and hemorrhagic effusion occur in the lungs and may be of extreme severity. Tetany of the smooth muscle of the intestinal tract occurs, rigid contraction of the pylorus and colon being repeatedly reported. Parenchymatous tissue suffers trauma, manifested as cloudy swelling and more advanced stages of degeneration. Essentially similar findings are reported to occur in animals killed by heat stroke (Brown [60]).

The author was privileged to examine and report upon the tissues obtained by Hall and Wakefield [34] in their heat-exhaustion investigation. These findings are of such significance as to justify elaboration in the general discussion of heat stroke.

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[22] See footnote 22 on p. 487.
[34] See footnote 34 on p. 491.
[37] See footnote 37 on p. 492.
[39] See footnote 39 on p. 493.
[52] Bernard: Lectures to the College of France, 4: 209, 1858.
[53] Wood: Am. Jour. Med. Sc., 46: 377, 1863.
[54] Sefftleben: Berl. klin. Wchnschr., 44: 775, 1907.
[55] Fayrer: Tropical diseases, Allbutt and Rolleston, p. 771, 1909.
[56] McKenzie and Le Count: Jour. Am. Med. Assoc., 71: 260, 1918.
[57] Simpson: The practice of medicine in the Tropics, Byam and Archibald, 3: 1967, 1923.
[58] Fabris: Riforma med., 39: 775, 1923.
[59] Haberda: Lehrbuch d. gerichtlichen Med. Berlin, p. 726, 1927.
[60] Brown: North Am. Vet., 2: 431, 1921.

The gross findings in these dogs are consistent with the reported findings in fatal cases of heat stroke. Decomposition is rapid in onset and generalized bacterial invasion occurs so that tissue from some of the dogs is not included in the final analysis. Tetany of the left ventricle and of the intestinal tract is noted. Tetany of the pylorus, associated with a dilated stomach filled with fluid and blanched rigidly contracted intestines, is found and is regarded as significant evidence that water assimilation is inhibited to a marked degree in heat stroke that has an associated tetany.

The circulatory findings in the myocardium vary. In the dogs that died soon after exposure the arterioles are contracted and bloodless, as are the capillaries. In those that survived longer there is an increased amount of blood in the arterial system. In all, the venous system is engorged, and in some of the veins the blood is disintegrating. An occasional small hemorrhage occurs beneath the endocardium or pericardium. The muscle fibres are definitely damaged. Longitudinal striation is coarse and accentuated. Transverse striation is fine and indistinct. Schafer[61] states that weak acids make the longitudinal striations more conspicuous. Some fibres are swollen, with loss of sheath outline and granular degeneration of sarcoplasm. Continuity of fibres is frequently broken by transverse ragged ruptures. The nuclei, particularly in the anemic type, tend to be cuboidal or rectangular in shape.

The pulmonary lesion suggests a profound acute intoxication. In type and degree it is comparable with the edema and infiltration the author observed in the lungs of a case that committed suicide by drinking 500 c. c. of commercial formalin. The vessels are packed with blood, some of which is disintegrating. In areas there is an associated hemorrhagic effusion that assumes the proportion of an infarction. There is an interstitial infiltration in the alveolar walls that is so massive in areas as to lead to practically a complete consolidation. The capillaries in the alveolar walls are tortuous, and there is a dense cellular infiltration. Many of these cells are of unidentified type. Endothelial cells are relatively abundant. Polynuclears, lymphocytes, and plasma cells are less common. A considerable quantity of nuclear débris and blood pigment is present. The bronchi are constricted and the bronchial mucous membrane is thrown into folds. It is undergoing a degenerative process, more pronounced in the superficial layers. In some this has reached a stage of necrosis. Coagulated albumin is abundant in the lumen of the bronchi. The alveoli are comparatively free of exudate. The reaction is more severe in animals that die soon after exposure than in those that survive for a few hours. (Fig. 1.)

[61] Schafer: Quain's Anatomy, vol. 2, Pt. I, p. 179.

Cross sections of the colon reveal marked constriction. The lumen is of small area and filled with cellular débris. This consists of fairly well preserved glandular epithelium. The glandular structure of the mucosa is well preserved except for necrosis and erosion of the epithelium near the tips of the villi. Some congestion occurs in the muscularis and deeper layers of the mucosa. It is marked towards the tips of the villi. The epithelial cells of the entire mucosa are in an advanced stage of degeneration, the protoplasm being granular and cell outlines practically entirely gone. Many nuclei are still well preserved but karyorrhexis can be easily found. (Figs. 2 and 3.)

The liver damage is marked, but less severe than the pulmonary. The larger vessels are packed with blood and the sinuses are narrow and empty except for granular amorphous material. Blood pigment is abundant and some has been taken up by phagocytes. The majority of the hepatic cells show some degeneration. This varies from fine granulation and vacuolation to rupture of cell membrane and occasional nuclear fragmentation. It is diffuse rather than regional, although in some of the animals the degenerative process is more advanced in the central zone.

In the pancreas the parenchymatous degeneration is more marked. The cells are swollen and the protoplasm is finely granular. Cell outlines are practically completely lost and the lumen of the acini are filled with the granular material. The pancreatic ducts are contracted and contain some amorphous eosin-stained material. In some of the larger ducts the epithelium is separated from the basement membrane. The islands appear small as if compressed and the insular cells are very poorly outlined. Nuclear structure is still well preserved.

The spleen appears hemorrhagic, due to intense congestion of the vessels and sinuses. Blood pigment is abundant and large phagocytes packed with this pigment are numerous. Some of the follicles are fairly well preserved except for degeneration and nuclear débris in the peripheral zone. In others the degeneration is almost complete, the follicle consisting chiefly of cellular débris.

In the kidney the most extensive damage occurs in the epithelium of the convoluted tubules. Cloudy swelling is of marked degree. The protoplasm is undergoing fine and coarsely granular degeneration. Cells are swollen, few can be outlined, and the lumina are largely obliterated by granular material from the ruptured cells. The glomeruli are of normal size and are infiltrated to some extent with endothelial cells and lymphocytes. Some are anemic, but the majority are definitely congested. The capsular space is possibly increased some in size and is free of exudate. In some the glomerulus appears compressed and the capsule distended. The vasa recta are particularly congested and occasional small interstitial hemorrhages

occur in the pyramidal and cortical areas. Occasionally finely granular casts are found in the collecting tubules. Nuclei are relatively well preserved although a few in the convoluted tubules are disintegrating. This renal trauma is particularly severe in an animal that survived the first exposure and died following a second exposure two weeks later with blood chemistry findings of azotemia. (Fig. 4.)

The degenerative process is less severe in the adrenals. The zona glomerulosa may be shrunken and the cells degenerated, but this is not a constant finding.

The thyroid lesion is quite severe. Colloid is decreased in quantity and stains very pale. Many acini are shrunken and empty. Others are normal in size and empty, resembling lung alveoli. The epithelial cells are degenerated, many in an advanced stage, and separated from the basement membrane and scattered in the acini. Congestion is especially marked and small interstitial hemorrhages are occasional. (Figs. 5 and 6.)

The secretory cells of the salivary gland are swollen and appear hydropic. Cell outlines are fairly well preserved. Finely granular material occurs in the cytoplasm. The nuclei are hard to identify. They are apparently flattened out against the basement membrane.

No conspicuous changes are found in the testicles other than massive venous engorgement. Ovarian tissue also appears relatively normal except for the graffian follicles. Ova in undeveloped follicles are fairly well preserved. Those in developing follicles are degenerated, usually to the extent that they can not be identified.

Freeman[34] reports the following neuropathological findings in these heat stroke animals: An advanced degree of parenchymatous degeneration is apparent in the brain. This degeneration is evidenced by a loss of concave outlines in the ganglion cells, a reduction of the chromatin to a hyaline, bluish staining material, a breaking up of the cytoplasm into small strands and vacuoles and, finally, a washing out of the cytoplasm. The nucleus tends to become more opaque than normal and to lose its sharp differentiation; in some instances it is displaced to the side of the cell. The nucleolus remains intact in all but the completely destroyed cells. The appearance of halos about the minute rounded glia nuclei is interpreted as hydropic degeneration of the cytoplasm.

## Conclusions

1. Heat stroke is a thermoregulatory incompetency resulting from exposure to heat.

2. The clinical manifestations of heat stroke are of several types, but these various conditions have a common pathogenesis.

[34] See footnote 34 on p. 491.

3. Thermoregulatory failure may occur through cardiovascular collapse before hyperthermia develops.

4. Hyperthermia develops through failure to dissipate heat. It results from an unbalance of reaction between complex physical and physiological factors.

5. Profound acute metabolic disturbances occur in heat stroke.

6. The trauma resulting from heat stroke affects parenchymatous tissue and may cause a fatal morphological disorganization.

7. Tetany is an important element in heat stroke. It commonly affects the heart and may cause sudden death. It also affects smooth muscle and may prevent water assimilation through intestinal spasm.

8. Heat, per se, is not the cause of the tissue trauma.

9. The response to heat exposure develops toxic factors when thermoregulation fails.

10. The nature of these factors is hypothetical and undetermined.

11. Loss of water and salt is a significant fact in that it is a very important element in causing thermoregulatory failure and cramps. It probably also seriously embarrasses metabolic processes.

12. An uncompensated acidosis occurs in heat stroke. This, as yet, can be attributed to no single acid body and the condition probably results from the accumulation of the various acid products of metabolism.

13. An acute massive interstitial pneumonitis occurs. It is of sufficient degree to decrease materially the vital capacity and retard respiratory exchange.

## Summary

Heat, accelerated metabolism, depletion of tissue fluid, decreased respiratory exchange, increased hydrogen ion concentration, and parenchymatous degeneration represent the sequence of essential events in the pathogenensis of heat stroke.

## Acknowledgment

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# EXAMINATION OF CANDIDATES FOR AVIATION TRAINING[1]

By G. C. Rhoades, Lieutenant Commander, Medical Corps, United States Navy

This article is written because it is thought that a brief outline of the examinations, various problems, numerous checks, and so forth, that are given during the course of training of candidates for avia-

[1] From United States Naval Air Station, Pensacola, Fla.

tion pilots, both officers and men, here at Pensacola Naval Air Station, might prove at least interesting, and perhaps helpful, to other medical officers in the service who are called upon to examine and select candidates for aviation training.

Prior to January, 1928, four classes, numbering from 60 to 80 members, were started in training for aviation pilots each year, on the 1st of January, April, July, and September, respectively. At the present writing, 10 candidates start their training each week. This new system should materially increase the number of students who will successfully complete the course each year. Each candidate is required to get in a minimum of 200 flying hours (75 of which must be solo) in the various types of planes assigned for this work before the course is completed and before he gets his designation as a heavier-than-air pilot. As student aviators fly only one-half of each day it takes approximately nine months to complete the course. The other half of the day is spent in attending ground school where instruction is given in aerodynamics, aerology, catapults, communications, engines, structure and rigging, navigation, and so forth. The last is given in conjunction with the flight training throughout the course. Each class is divided into two wings, right and left, one of which flies from 8 a. m. until noon, and attends ground school in the afternoon. The other wing is instructed in reverse order. The wings alternate each week so that each wing gets the same amount of morning and afternoon flying.

As there are nearly 200 officers and men under aviation training at all times, it has been found practically impossible for all of the flight surgeons stationed here to know thoroughly, as they should, each of these candidates.

During the current fiscal year one flight surgeon has been assigned to each class. His duties require him to examine each candidate, to make a prognostication as to whether he will fail or pass the course, and to follow the class through its various stages of flying until it graduates. In this way the flight surgeon, so assigned, soon gets to know more or less intimately each of its 70 or 80 members, since he reports with them wherever they are flying at 8 in the morning and stays with them until 4 o'clock, when flying for both wings is secured for the day. They become, more or less, his wards; he watches their progress throughout the course, talks to and advises them professionally, treats minor ailments, and tries at all times to keep himself informed as to their progress in flight training, and of their general mental and physical condition.

As soon as candidates arrive they report to the flight surgeon at the dispensary where they are given an examination identical with

that originally required for candidates for aviation. This is done for two reasons. First, it has been found that many months may elapse from the time they receive their original examination for flying, until they report here, during which time disqualifying defects may develop. Secondly, the flight surgeon is required to prognosticate as to whether the candidate will fail or pass the course, and needs the valuable information that may be obtained by carefully watching, mentally noting, and, in the vernacular, "sizing up" the candidate all through his physical examination, and the examination in the eye room.

If one is observant while making this complete recheck of the candidate, and studies him so closely that nothing, no matter how trivial it is, escapes his notice, it will be found when the time comes for the psychological examination that one already has a fair knowledge of the candidate, which will be further rounded out by the later examination and by the various reaction-time tests which are given to him.

During the physical and eye examination many personality characteristics can be determined, such as temperament, intelligence, and volition. If the candidate is told to hop around the room on his left foot and starts off on his right, one has reason to think that he is not very attentive and may confirm this as the examination proceeds, particularly in his response to the directions that are given him during the test with the phorometer. A candidate who has to be told what to do several times will raise one's suspicions as to how far he will get in his aviation training, for one knows that his instructors will have no time to repeat instructions while he is flying. The objection may be raised that this is not a fair test of the candidate's attentiveness, for in the air he would naturally be most attentive. Nevertheless, it has been found that the candidate who is inattentive in the examining room, under no stress or nervous excitement, is even less capable of concentrating in the air, where he has continually to be thinking of many things, and at the same time be listening, over the noise of the motor, to the instructions given by his instructor through his Gosport helmet. It seems a common fault, for many pilots will come over to you and say, "I can't get half my instructions across to so-and-so."

During the examination one can determine the candidate's tempermanent, whether cheerful or depressed; his cooperation, etc.; and, to a certain extent, his volition, whether quick or slow, alert or hesitant, energetic, etc. At the end of it one will have learned perhaps that he has no physical disqualifying defects, and at the same time will have made a fairly good estimate of his outstanding characteristics.

Fig. 1.—Student wearing Gosport helmet

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Fig. 2.—Chief flight instructor and student. Student is wearing Gosport helmet and is carrying its tubing and mouthpiece in left hand

Fig. 3.—Chief flight instructor wearing mouthpiece of Gosport helmet

Fig. 4.—Chief flight instructor and student in training plane. Student wearing Gosport helmet, mouthpiece of which is worn by instructor

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One now proceeds with the psychological examination, which is as thorough as time permits. In its course one satisfies oneself as to the candidate's family history, personal history, his social life, education, habits, hobbies, and occupations, his worries, phobias, complexes, and athletic ability, and finally the effect of the wear and tear of the world on his nervous system, his mentality, and his make-up.

Following this the candidate's reaction time is determined by the word-association test, in which a stop watch is used to determine the interval of time, in seconds or fractions thereof, from the instant one gives him a word until he answers with the associated word; 100 words are given from a selected list, and the candidate's reaction time is the average in seconds of all responses. One can also determine whether the candidate is retentive or not retentive, accurate or inaccurate, by noting the mistakes he makes when one requires him to repeat the same answers to the word association test when given to him a second time, though no time element enters into the second test.

During the last six months the candidate's reaction time has also been measured by giving him a set of dominoes which he is required to place together, matching the numbers end to end by running them out in a single line. His performance is timed with a stop watch. It is thought that this will prove to be a very valuable test when enough candidates have been examined to determine the standardization time for those who are successful. During this test one can determine whether the candidate is decisive or indecisive, controlled or restless, steady or nervous, precise or vague, for many get excited and move around in the chair, some get fidgety, many are hesitant, while other do the test in spurts or fumbles.

By this time one to two hours have been spent with the candidate, and one should be conversant enough with those characteristics which are particularly interesting and which one is looking for to round out the mental picture of his qualifications. Just how to do this remains entirely with the examining flight surgeon, but some standardized system of correlating one's impressions must be evolved, or much of the information will be of no value when coming to the final summing up of the student. The more complicated the system of markings, the less valuable it becomes, hence it has been found advisable to reduce one's deductions down to three classes—"Above average," "average," "below average"—and to grade candidates as to aeronautical adaptability accordingly.

To arrive at these ratings it is advantageous to sum up the candidate's characteristics by use of the descriptive table below:

| ABOVE AVERAGE | AVERAGE | BELOW AVERAGE |
|---|---|---|
| Cheerful. | Sober. | Depressed. |
| Aggressive. | Modest. | Submissive. |
| Intelligent. | Moderate intelligence. | Stupid. |
| Precise. | Moderate precision. | Vague. |
| Quick. | Average. | Slow. |
| Retentive. | Moderately retentive. | Not retentive. |
| Controlled. | Moderately controlled. | Restless. |
| Attentive. | Moderately attentive. | Inattentive. |

It is not difficult to determine these eight outstanding qualities during the examination, and they are checked off as noted. If the majority are found in any one column the candidate is thus graded. More frequently, however, the candidate will be best described by two or three words in each column. The number and position of these are checked, and he is graded according to the location and preponderance of the words best describing him.

From the deductions that are made from the above table, and the average of the candidate's various reaction times, together with his physical and mental examination, the flight surgeon makes a prognostication as to whether he will fail or pass the course. This latter classification is most important and most difficult to make. In making it one must put together every impression that has been gained from the time the candidate first reports until he is dismissed after the psychological examination. It will be found that each one has many faults. These must be weighed against his numerous good traits. Note carefully in what grade he is placed. A candidate classified as below average will practically never be prognosticated to pass the course. One must be very careful not to let one's first impressions run away with one's better judgment. Frequently the candidate perceives in the course of the examination that he is under strict surveillance, and naturally he tries his best to leave with the examiner the most favorable impression possible, by always putting his best foot forward. Allowances must be made for this trait, at times so noticeable that one can not mistake it, for it is very evident that the mental picture one is getting of such a candidate is much distorted. Indeed it is best when confronted with this problem to stop, and to regain the candidate's confidence by getting him into an animated conservation. Soon he will be off his guard, will have forgotten his intentions, and will become his normal self. The examination may then be resumed, and the impressions gained will be more approximately his normal make-up.

It is much easier to say that a candidate will fail than it is to say he will pass the course. This is unfortunate, as it costs the Govern-

ment approximately $100 an hour to train a student, and naturally it would much prefer to know the ones who will pass rather than those who will fail.

To date no way or system has been sufficiently developed with which one can examine the candidate and state with absolute assurance that he will pass. About as strong a statement as a flight surgeon should make is to hazard a guess that a candidate will pass. One can determine definitely that a candidate is passable material, but numerous things will come to the surface during his first 10 hours of dual instruction in flying which disqualify him, that to date one has no way of bringing out during the examination.

It is hoped, with the many mechanical instruments of precision—orientators and so forth—that are being perfected, together with electrically controlled timing devices, as well as the making of graphs, and so forth, that these, together with the information now obtainable, may definitely solve this difficult problem.

As conditions exist at present, it is thought advisable, after carefully selecting only those who are found physically qualified and temperamentally best adapted for aviation training, and until these hidden disqualifying defects can be definitely brought out in a candidate, that it will serve the best interest of all concerned to give them the acid test; that is, to start the candidate under flying instruction, and thereby establish, once and for all, whether he can or can not make the course. Worthless flying material is always rapidly eliminated. One might say, Why go through all these physical examinations, various tests, as well as psychological examination, when the candidate is going to be given flying instructions, and thereby tested in that way? The reason is to try to show that the original examination of the candidate should be most thorough, and that the marks he is given for aeronautical adaptability should only be arrived at after a complete summing up of all the facts brought out during the examination.

When students come up for solo checks during their instruction in flying they are never given the benefit of a doubt. It is too hazardous a chance for the check instructor to take, as the student's life may depend on his decision. The same should apply when making the original examination. If there is any doubt in the flight surgeon's mind as to whether the candidate is good flying material, he (the flight surgeon) should take the benefit, and give the candidate the doubt. No doubtful material ever got through the course of training for aviators as given here at this station.

The course of instruction in flying starts with primary seaplanes, followed by primary land planes, and cross-country flights, then service seaplanes, gunnery, torpedo planes, and navigation flights. Officers are also given training in the observation and combat squad-

rons. All during the instruction in primary seaplanes, primary land planes, and service seaplanes (which takes about 130 hours), the instructor is required to make out a chit every five hours showing the progress his student is making, by giving him marks on the various maneuvers he is being taught, and, in addition to this, the student is being continually checked by the chief flight instructor until he finishes the course. If at any time his work or checks are found to be unsatisfactory, he is brought up before the flight school board, which can either recommend additional hours, or send him to the advisory board (composed of the senior aviators on the station). This latter board, after a complete review of his work, either recommends additional time or that the candidate be dropped.

It has been found that approximately 35 to 40 per cent of the students under flying instructions are eliminated during the first 10 hours of the course, which consists of two indoctrination flights of one hour each, by the instructor, during which time the plane is put through various maneuvers which are explained to the student, and after this the dual instruction of one hour each day, continuing for 10 hours, during which the student is taught the simple primary maneuvers of flight. That is, level flight, glides, climbs, turns, landings, take-offs, spins, and conduct in emergencies. All these must be thoroughly mastered by the student within 10 hours, as at this time he is turned over to the chief flight instructor, who goes up with him and carefully checks him on all these primary maneuvers, as well as giving him emergency "cut gun" landings. If the check instructor is satisfied with the student's work, he is allowed to solo and continue his training; otherwise the candidate is referred to the flight board, then the advisory board, and by them given additional time or dropped.

It is not surprising that so large a number are dropped when one realizes that a student all during his course of instruction (especially the first part) is under more or less of a nervous strain, for, in addition to the actual development of mechanically well-controlled movements and correct judgment of speed, height, and distance, and having to be able to execute properly difficult maneuvers, all of which are foreign to him, the student is also required to be constantly checking the various instruments of the plane, such as oil-temperature gauge, pressure gauge, revolution indicator, altimeter, switches, and gas supply, plus the following out of the course rules and maintaining a careful watch for other planes, as well as at all times knowing the wind direction for immediate landings. This rather formidable list, which always has to be considered, as well as the student having to know instantaneously what to do in case of emergencies, makes one wonder why the percentage of failures is not even greater.

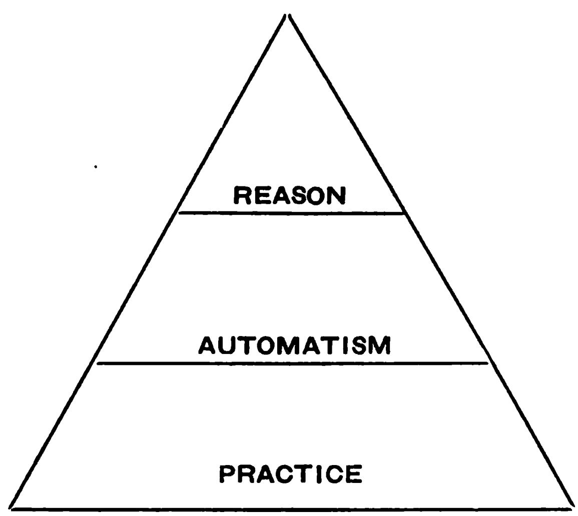
When it is considered that flight itself is a three-directional movement, an experience altogether unfamiliar to the race, some doubt should be entertained as to the capability of the optimistic souls who promise to train normal young men with only two or three hours' instruction in the air. The result of such training as to safety, skill of those so trained, and the harm such pilots may do to future aviation, deserve thorough consideration before any indorsement of such a system of training be given.

The following ideas were obtained by reading "Mental Handicaps in Golf," by Theo. B. Hyslop, M. D.

As the student progresses with his course the fundamental principles of flying become stabilized with time and experience in the air, and it is essential that not only should the operative mechanism become primarily automatic and secondarily regulative by the mentality of the flyer, but that the mental operations themselves should also be stabilized and regulated subconsciously, thus leaving to the higher brain the functions of discrimination and judgment. It follows, therefore, that the higher functions should be the ultimate controlling determinants, and that the more stable the subconscious and automatic functions, the more free and efficient do the higher determinates become.

It no longer remains a mystery why success as a flyer is not always obtainable when we consider the various levels to which students attain. In order to climb the ladder to success it is absolutely essential that the lower rungs should be relegated to the subconscious and physiologically automatic.

The following diagram may help to demonstrate the relativities of the flyer, and each level of attainment is to be reached only by thoroughly grasping the relative values of the various levels.



The reasoning faculty should rise above the emotional and even the volitional.

Since there are such a large number of student aviators dropped at the end of their 10-hour dual instruction (from 35 to 40 per cent) it may prove instructive and interesting to know with what strange problems the student is confronted, how perfect his judgment as to speed and distance must be, how accurately he must correlate all his control movements, and just how he is taught to make all these simple primary maneuvers by the pilot instructor.

The following instructions and explanations, as given to students during the 10-hour dual instruction, are as outlined by Lieut. C. A. Collins, United States Navy, the writer's instructor.

Before going into the air a thorough description of the three sets of controls, aileron, rudder, and flippers, and the movements resultant from their use, are given the student.

Thus: To depress the nose and enter a glide the stick is moved slightly forward, or to lift the nose and enter a climb the stick is moved slightly aft. Similarly to swing the nose to right or left (in the horizontal plane) the rudder bar is moved forward slightly with the right or left foot, according to the direction in which you desire to swing the nose.

To depress the right and lift the left wing the stick is moved sideways to the right. Movement of the stick to the left results in the opposite of this, depressing the left wing and raising the right wing.

*After any movement of the control the stick is returned to neutral when the desired movement of the plane has been obtained. Failure to return the stick to neutral causes a continuance of the applied control effect with resultant further displacement of the plane.*

During the student's first hour the instructor puts the plane in level flight at a safe altitude. The controls are then in neutral. Disregarding air disturbance or lack of proper balance in plane itself (shifting of weight or improper alignment and unconscious control movement by the pilot) the plane will continue in level flight.

The attempt is, therefore, to get the student to move the controls as little as possible, and only to correct an obvious displacement of the plane. Practically all students in attempting to correct apply excessive pressure or overcontrol, and thus are quite apt to increase the error. They are also given to applying control unconsciously when none is needed. To establish a basis in the student's mind of the pressure and amount of movement necessary, it is well to have him move the controls one at a time while in the level flight position

to their maximum extent. The effect of this immediately demonstrates, or should, the necessity for gentle handling of the controls. Thus the correction over the voice tube through the student's Gosport helmet when in level flight are normally such as: "Keep your nose on the horizon"; "Back a little on the stick"; "Too much"; "Keep your wings level"; "Left aileron"; "You are dragging your right wing"; "Your nose is swinging to the left"; "Hold a little pressure on right rudder to keep it going straight," etc.

As soon as the student can hold the plane in level flight with any success he is shown how to glide as follows: To enter a glide move the stick forward gently. When the nose has dropped about 20° return the stick to neutral, and keep the nose at that angle. Then, to enter a climb move the stick back slightly raising the nose about 5° above the horizon, and hold it there.

### TURNS

Turns are the next step in instruction.

To make a right turn, right rudder and right aileron are applied simultaneously. When the desired angle of bank and rate of turn are acquired, the controls are neutralized. The bank is then maintained steady with the aileron and the rate of turn with the rudder. When it is desired to come out of the turn, the left aileron and left rudder are applied simultaneously until the wings are level and the nose has ceased to swing. Then the controls are again neutralized. The most common fault of students in a turn is skidding. This is due primarily to using too much rudder, and secondarily to failure to bank the plane sufficiently, or lack of aileron. In attempting to make a turn, right rudder alone will swing the nose to the right, the plane continuing sideways along its original flight path. Banking the plane by use of the aileron interposes the wing surfaces against the air ahead and counteracts the tendency of the plane to travel in a straight line. Therefore, both aileron and rudder are necessary to make good turns. Steeply banked automobile racing tracks aptly illustrate the necessity for banking a plane in turning. In the former, the track itself supplies the horizontal resistance for the automobile, and for the plane it is necessary to bring the wings somewhat broadside to the air ahead by banking to supply the necessary horizontal resistance.

The foregoing statements for instruction purposes are sufficiently correct, though not, strictly speaking, accurate. Thus, in either a glide or a climb, a very little up flipper is needed to prevent dropping of the nose. So, also, in a turn, comparatively heavy initial rudder and aileron are needed to change the direction of travel.

Once in the turn, slight rudder to the turning side and slight up aileron on the low wing are needed. Owing to the student's lack of finesse of control movements and proper judgment of correct amounts to be used, any involved explanation is avoided in instructions. Further, the rapidity necessary for various maneuvers prevents complicated explanations. Thus, the simplest possible directions during air instruction are most likely to achieve the greatest development.

### LANDINGS

For instruction, landings are divided into a series of steps—the glide, breaking the glide, leveling off, stalling, touching water, and the run on water until speed is lost. A finished landing is the bringing of the plane to rest on water from flight in the air, touching it at the lowest possible speed and with the minimum possible amount of jar. To decrease the forward speed of the plane at the time of contact with water, landings are always made directly into the wind.

The gun being cut (engine throttled down) at from 50 to 75 feet, plane headed directly into the wind, the stick is moved forward to enter a glide. It is then returned to neutral to maintain a steady glide. At about 15 feet above the water the stick is brought back very slightly, thus causing a flatter glide (this is called breaking the glide). At from 3 to 5 feet above the water the stick is moved back to make the plane fly level at that height above the water. The attempt then is to hold the plane off the water as long as possible by coming back on the stick and without causing the plane to rise. Thus the nose gets higher and the tail lower until the stick is all the way back. The plane will then have lost flying speed, or is stalled, and is settling toward the water. It should touch just after the stick is all the way back. The stick is then held back until the plane loses its speed on the water. During the entire maneuver the wings must be kept level by use of the ailerons, and swinging of the nose must be prevented by use of the rudder. Variations in speed of the glide are to be avoided, a constant rate of speed being aimed at. The reason for this is that with an increase in speed, control movement is increasingly effective. Thus, up-flipper, sufficient to break the glide at 45 knots, would cause the plane to zoom high up in the air at 80 knots. Once the student has become proficient in landing at any definite speed a variation will introduce no particular hardship.

#### TAKE-OFF

As in landing, instruction in take-offs is divided into steps. The plane is first idled into the wind. During the take-off, aileron and rudder are used to maintain the wings level and prevent swinging of the nose. First the stick is brought all the way back, the engine throttle is opened steadily to full position, the nose rising. When it will not rise any higher the stick is allowed to go to neutral. In this position the plane rapidly picks up speed. At from 15 to 20 knots the stick is put forward all the way, which causes the nose to go down, putting the plane on the step. When it goes down the stick is returned to neutral and the take-off is completed by holding slight upflipper. When in the air, the nose is allowed to drop to level flight to gather excess speed before starting a climb. The above take-off is used in smooth water.

In rough water it is varied by not putting the stick forward to get on the step. In a rough water take-off it is most important to hold the stick back when starting, to prevent picking up water with the propeller. As in the other take-off the stick is eased forward to neutral and the take-off completed as before.

#### SPIRALS

Instructions in spirals ordinarily commence when a student is able to take-off, land, and make turns. A spiral bears the same relation to a turn that a glide does to straight flight. In other words it is a gliding turn. Owing to the lack of propeller air streams on the tail surfaces in a spiral, both rudder and flipper control are less sensitive than with the engine on. To make a right spiral the engine is idled (throttled down low) and right rudder and aileron are applied simultaneously as in a turn. At the same time, however, the stick is put forward to make the plane glide. When the spiral has been entered, i. e., nose sufficiently depressed, correct bank obtained, and a steady swing of the nose to the right, the controls are neutralized. To recover, left aileron and left rudder are applied simultaneously to level the wings and check the swing of the nose, the plane thus being brought into a straight glide.

Lack of propeller air blast requires somewhat greater actual movement of the rudder toward the turning side, though the pressure required is less, for the same reason. As in turns, the most useful fault is skidding both on entering and recovering from the spiral. An additional reason for skidding is that, in order to obtain a good rate of turn in a spiral, considerable bank is necessary and students are prone to keep their wings too close to level.

### SPINS

The supporting force in flight is obtained from the air action on the wing surfaces, the greater part from the upper surface and not the lower surface as one might suppose to be the case. If the nose is brought higher and higher, a point will be reached where the forward speed of the plane does not engender sufficient lift from the wing surfaces to support the plane. This point is known as the stalled position. The plane so placed will, if the controls are relaxed, either go into a dive straight ahead or fall off to one side. As soon as the downward speed surpasses flying speed, lift is again obtained from the wings. If, when stalled, the stick is held back, the plane can not pick up speed, because as soon as it starts to do so the upflipper lifts the nose; thus a series of stalls and attempted dives will ensue. Further, if in addition to full upflipper, full rudder is applied to one side, the plane will turn toward that side in attempting to pick up speed, and will fall off toward that side when stalled. The result of so holding up flipper and full rudder is known as a SPIN. Actually, the dives and stalls are not always apparent. However, with the nose pointing down, as in a spin—a position from which normal inclination would lead one to expect that upflipper would lift the nose—the stick must be put forward to recover speed before the nose can be lifted. The nose drops because it is heavy. The upflipper prevents the regaining of flying speed. If the stick is put in neutral, the plane will dive and pick up speed, and the nose can then be brought up.

Anyone will recognize a stall from level flight, but in a turn or spiral or other maneuver a loss of flying speed is not so readily apparent. It is therefore essential before allowing a student to solo to demonstrate stalls, recovery from stalls, and spins and their recovery.

Therefore the student is instructed to enter a spin by applying full upflipper and full right (left) rudder; when in the spin he is taught to recover by putting the stick forward and applying full left (right) rudder.

Probably the mistaken judgment of pilots and students, instantaneously made, that because the nose was pointing down flying speed was assured, has resulted in more crashes than any other cause.

# PHYSIOLOGY OF RESPIRATION IN RELATIONSHIP TO THE PROBLEMS OF NAVAL MEDICINE[1]

By Eugene F. Du Bois, Captain, Medical Corps, United States Naval Reserve; Medical Director, Russell Sage Institute of Pathology; Associate Professor of Medicine, Cornell University Medical College

## Part III

## SUBMARINE VENTILATION[2]

### I. Introduction

The problems of air purification in a submarine while submerged are similar to those encountered in a respiration chamber. There is no communication with the outside air, and if the boat is to remain submerged for any considerable period of time it is necessary to make provision for the renewal of the oxygen that is consumed and for the absorption of carbon dioxide produced. If the air be not purified in this manner after 12 to 21 hours the men will suffer mild respiratory distress, then they will begin to show signs of increasing physical and mental suffering, and finally they will suffocate. With proper air purification the submergence may be prolonged to 96 hours without discomfort, as in the case of the *O–10*, and there is no reason why longer periods should not be attained.

So much of the work on submarines has been of confidential nature that the lay press has many curious misapprehensions. In the recent excitement over the loss of the *S–4* one of the papers, in an editorial, spoke of the discomfort caused to the crew by the enormous changes in air pressure. This, of course, is nonsense because the submarine maintains during a submergence practically the same barometric pressure as when on the surface. Another newspaper asked bitterly why the authorities responsible for the submarines did not know about the methods of air purification used in pneumonia-oxygen chambers. It so happens that at the present time all the pneumonia chambers are purifying the air with Navy soda lime devised for our submarines in 1918. As a matter of fact, the various bureaus concerned have not only been well informed as to all the advances in air purification but they themselves have conducted many important tests, as will be shown later.

Under ordinary conditions the periods of submergence are so short that air purification is not required. The Great War, however,

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[1] From the Russell Sage Institute of Pathology in affiliation with the Second Medical (Cornell) Division of Bellevue Hospital, New York.

[2] The first portion (1) of this series was published in the January, 1928, number of the United States Naval Medical Bulletin; the second portion (2) in the April, 1928, number. This third portion consists of a revision of Submarine Ventilation Bulletin No. 4 (3), compiled by the writer and published for confidential use by the Bureau of Medicine and Surgery, March 15, 1919. This issue was exhausted shortly after its publication and copies are now scarce.

showed that at any time and without warning a submarine may have to remain submerged for several days on account of the presence of the enemy, or rough weather, or serious accident to the machinery. Fortunately such occurrences are rare, but every commanding officer must be prepared to meet such an emergency in a manner that will afford his men the greatest possible chance of survival. In order to do this he must have a general understanding of the whole subject and a knowledge of the procedures used on previous long submergences.

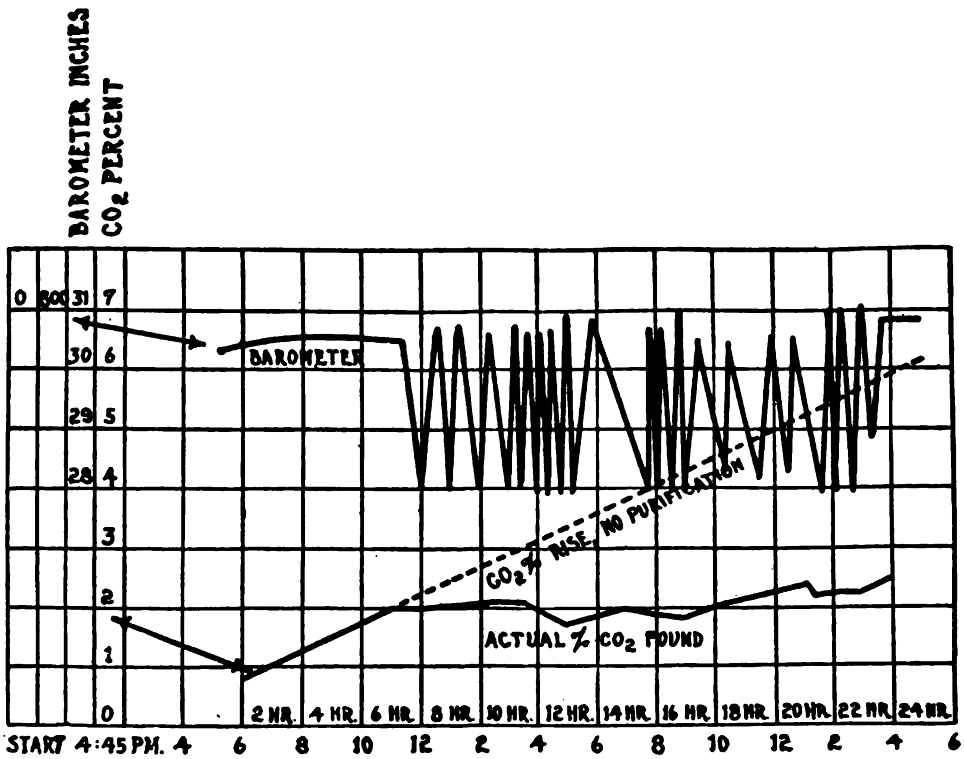


Chart I.—Test on U. S. S. *G-3*, showing method of renewing air from flasks

## II. Reports of Tests on Submarines

An extended series of tests on air purification in the submarines of the United States Navy was made in 1914 by a board consisting of Naval Constructor W. McEntee and Passed Asst. Surg. E. W. Brown, United States Navy. Most of the work was done in an experimental chamber, but some tests were made in boats of the E class, the longest submergence being nearly 17 hours. As the carbon dioxide given off by the respiration of the crew increased it was noticed that breathing was first affected at 3 per cent, became labored and exhausting between 4 and 5 per cent, and caused marked distress at 5 per cent. At the end of this period the oxygen had fallen to 14.6 per cent. This board tried out a large number of absorbents for

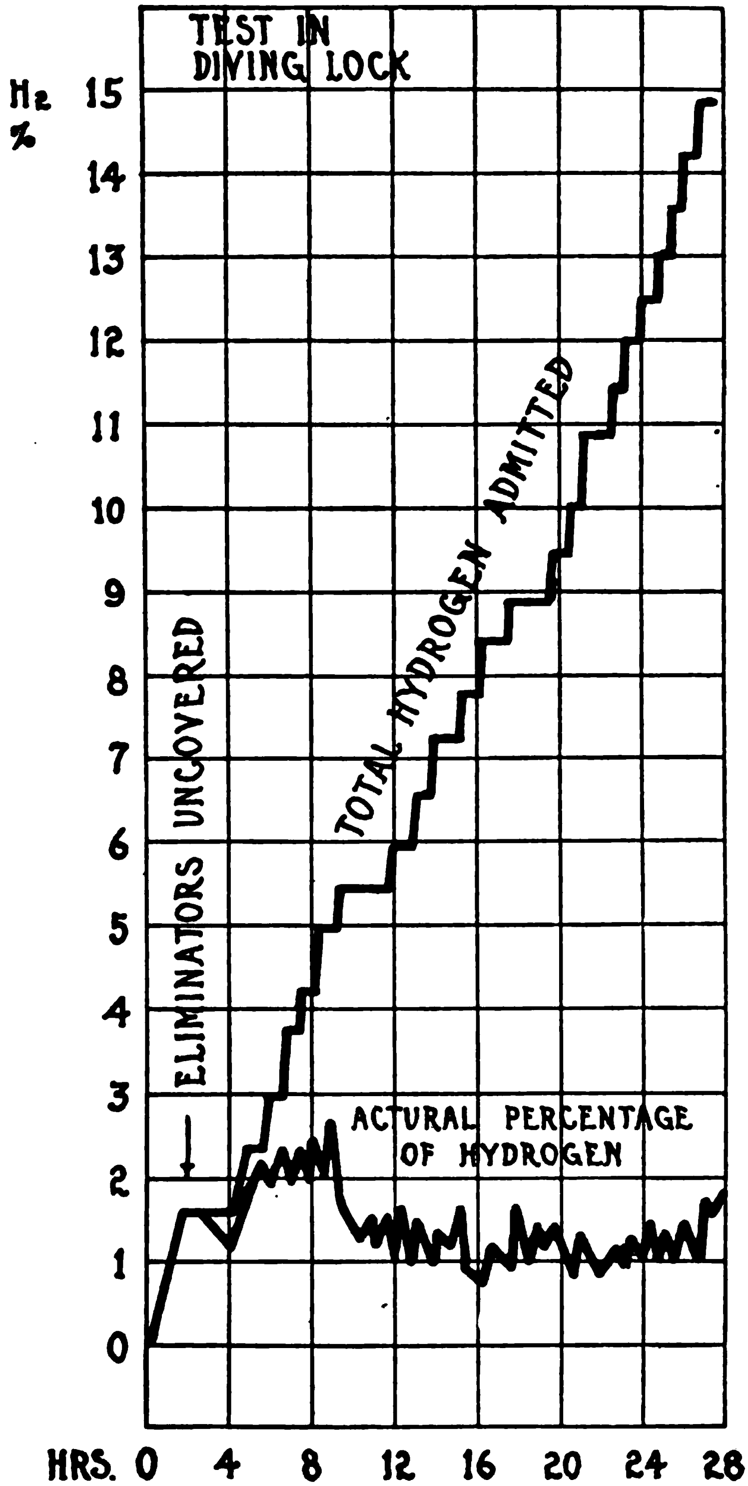


CHART II.—Test of hydrogen eliminators. The upper line shows what the percentage of hydrogen would have been without using eliminators. The lower line shows the actual percentage found after the eliminators were uncovered

carbon dioxide and obtained the best results with solutions of caustic potash. They found that on an average during submergences a man gave off 0.7 cubic foot of carbon dioxide per hour and consumed 0.9 cubic foot of oxygen.

The method of supplying fresh air from the flasks was tested by this same board on a 24-hour submergence in the United States submarine *G-3*, as shown in Chart I. The efficiency of the method was found to be 78 per cent. It was possible to keep the $CO_2$ between 1.65 per cent and 2.47 per cent by pumping air into an empty flask and then releasing fresh air until the original barometric pressure was restored.

The work was continued by Doctor Brown and others and successful submergences of about 48 hours were made using oxygen tanks and caustic potash and soda lime. One submergence was ended at 39 hours because it was found that the batteries gave off so much hydrogen that the percentage of this gas rose to 4.21, which is a dangerous mixture in the presence of sparks. This led to the recommendation that a Burrell hydrogen detector be used on submarines and that experiments be tried with the hydrogen eliminator devised by Philips and Steele of the British Admiralty.

In April 1918 a test on hydrogen elimination was made by the writer. (Chart II.) Palladized asbestos was applied to electric light globes in somewhat the manner used by Philips and Steele, but the material was found to have such great activity that no electric current was required. A diving lock was sealed, containing a dozen of these lamps, and 1 cubic foot of hydrogen was admitted every hour. The gas never increased beyond 2.6 per cent, although enough was admitted to produce 14.5 per cent if there had been no elimination. This same hydrogen eliminator was tested on several patrol cruises, and observations were made on the practical use of the soda-lime apparatus and oxygen tanks under service conditions (10) (11). (Charts III and IV.)[3]

The first soda-lime used in our submarines was made according to the formula of Haldane, the British physiologist. Unslaked

[3] *Method used in preparation of hydrogen eliminators.*—A saturated aqueous solution of palladium chloride is prepared. The salt goes into solution more readily when a small quantity of hydrochloric acid is added and driven off by heating the solution. Pure shredded Arizona asbestos (No. 90, Johns-Mansville Co.) is then added until it has absorbed all the solution. Then a strong solution of sodium formate is added slowly and the sodium hydrate solution (about 20 per cent) added until the mixture is neutral, as shown by litmus paper; then after standing for 30 minutes the clear liquid is poured off and the palladized asbestos is washed in distilled water six times. The wet shreds of asbestos are molded on the electric lamp and allowed to dry. It has been found that 16 grams of palladium chloride ($PdCl_2 2H_2O$; contains 60 per cent of palladium), with about 20 grams of asbestos, is sufficient to manufacture enough material for a dozen lamps. After they are made they should be dried in an electric oven, or allowed to dry in a warm room. The former method takes about 10 hours and the latter nearly 48 hours. A lamp can be dried in a few minutes by screwing it into a socket and turning on the current.

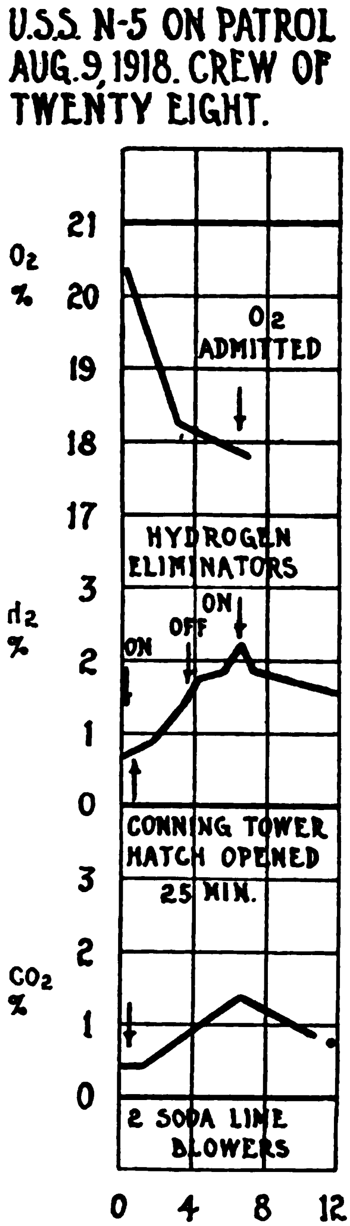


CHART III.—U. S. S. *N-5* submerged for 12 hours on patrol August 9, 1918; 24 hydrogen eliminator lamps were not able to prevent rise during early part of submergence when the percentage was low, but were able to cause an actual reduction after the sixth hour

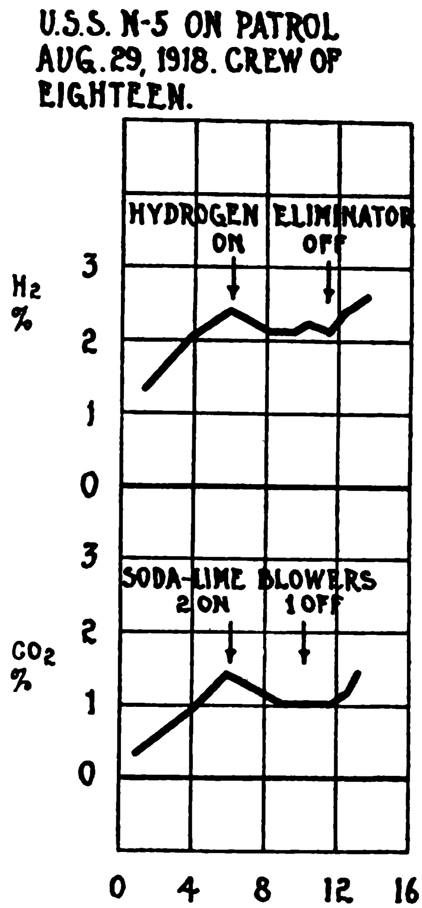


CHART IV.—U. S. S. *N-5* submerged for 14 hours on patrol August 29, 1918. Note diminution of hydrogen when the eliminators were uncovered and rise in percentage after they were covered again. The $CO_2$ was reduced by two soda-lime blowers, but rose after one blower was turned off

lime was ground and spread on a cement floor and to it was added from a watering can an equal weight of 5 per cent solution of caustic soda dissolved in water. During this process the lime was continually raked. A soft, flaky material resulted which was active in absorbing $CO_2$ but it was so soft that it had a tendency to pack in the cans, thus becoming impermeable to the air. During 1918 tests under service conditions showed that this soft soda lime was not satisfactory when used in connection with the Sturtevant blowers, and the Navy requested the aid of the Chemical Warfare Service, United States Army, in the preparation of a better soda lime. The gas-mask division was able to be of great help because it had conducted many tests on soda lime, which was the most important constituent of the war gas absorbing canister. The problem was solved by Maj. R. E. Wilson, who devised the method of manufacturing "navy soda lime" in hard granules which did not pack into impermeable masses even on rough handling.

In order to make a prolonged test of this new type of soda lime, a four-day submergence was made in the United States submarine *O–10*, Lieut. Commander S. Picking, United States Navy. commanding. Air analyses were made by Lieuts. E. F. Du Bois and G. M. Mackenzie, Medical Corps, United States Naval Reserve Force. (Chart V.) During the 96 hours under the surface the personnel of 33 engaged in their usual activities, making repairs, etc., and suffered no discomfort except mild headaches, which affected more than half the crew. The two soda-lime blowers were supplemented occasionally by a third. One cylinder of oxygen was released every 6 hours and two cans of soda lime were used about every 5 hours. The $CO_2$ never rose above 2.4 per cent, and the oxygen was maintained above 18.2 per cent. At the end of 4 days, with air purification, the air smelled no worse than it often does after a 6-hour submergence without purification.

Between 1914 and 1919 the representatives of the Bureau of Medicine and Surgery made many observations of the air conditions on American and British submarines and determined the rate at which $CO_2$ was produced and $O_2$ absorbed by the crews. The efficiency of the air purification system was also tested under actual service conditions.

In 1924 Lieut. Commander R. F. Jones, Medical Corps, United States Navy, and Lieut. G. H. Mankin, Medical Corps, United States Navy (4), reported their studies of submarine ventilation in tropical waters. They found that men were able to stand their watches with an air temperature of 83° to 86° F. (wet bulb) without any notable degree of physical exhaustion or discomfort in spite of the high humidity while submerged. The outside water was about

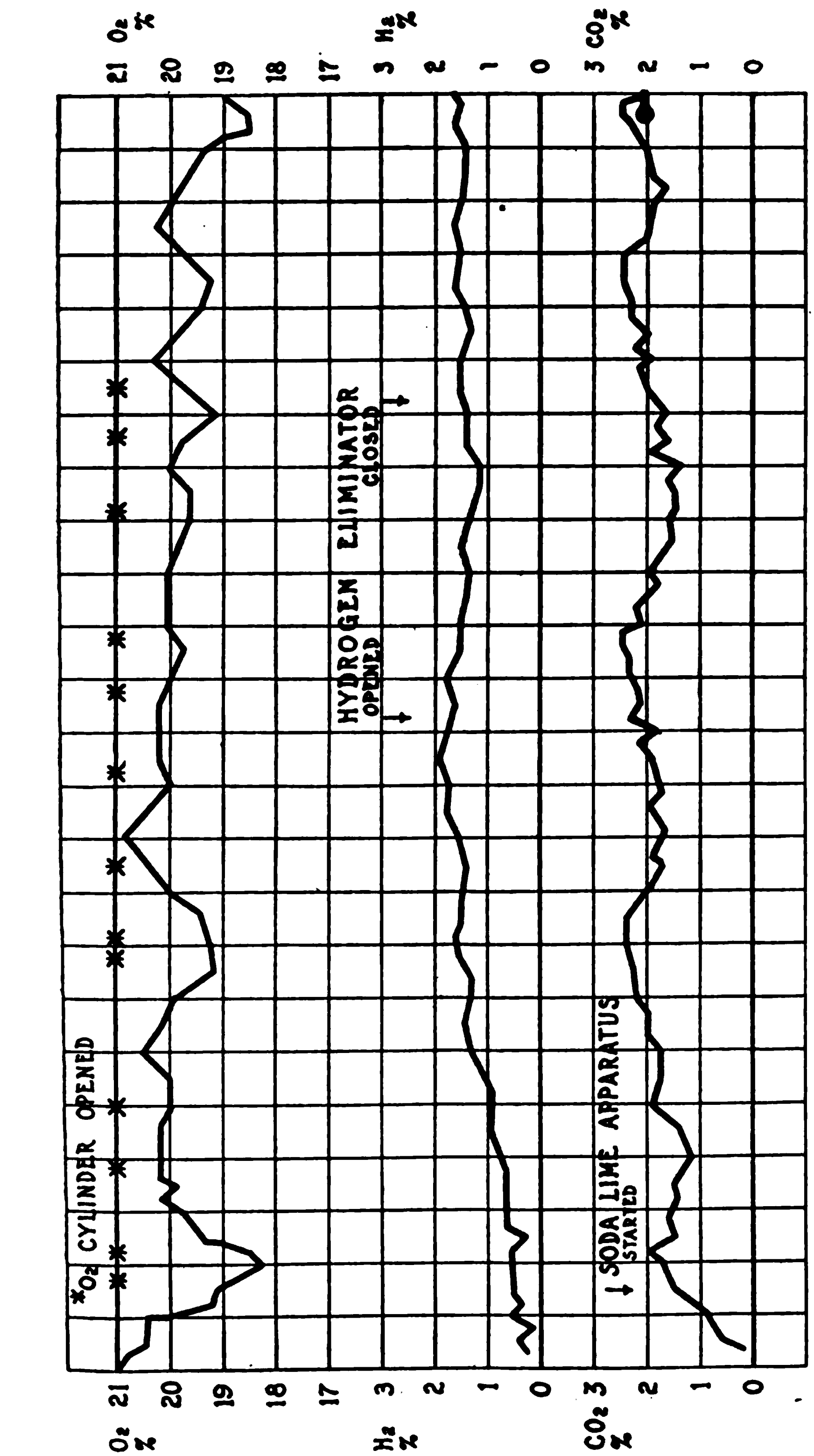


CHART V.—96-hour submergence on U. S. S. *O–10*. The rise in hydrogen was very slow and was easily checked by the eliminators. The stars represent the points at which new oxygen cylinders were opened

82° F., and a difference of only 3° to 5° F. between this water and the interior of the boat was sufficient to eliminate the heat generated, except during the periods when the galley range or motors were operating.

At the present time Commander E. W. Brown, Medical Corps, United States Navy, is engaged in a study of the degree in rise of $CO_2$ that is required to produce inefficiency and exhaustion of men in submarines. This study is of the utmost importance because any factor which tends to decrease the mental efficiency of the officers and men is a source of great danger to a submarine which may have to extricate itself from a difficult situation or come to the surface and fight.

Of course the periods of long submergence are the most dramatic and the most interesting from the physiological standpoint but they are relatively infrequent. For 99 per cent of the time the comfort of the men depends on the system of outboard and intercompartmental ventilation. This subject has received a great deal of careful study from the Bureaus of Steam Engineering and of Construction and Repair. On the whole, the submarines have become more comfortable as they have increased in length, but the increase in comfort has never been proportional to the increase in mere size. For an interesting discussion of the habitability of submarines the reader should consult the recent article by Capt. D. N. Carpenter (5).

### III. Gases Occurring in Submarines

The gases which occur in submarines are fairly numerous, as will be seen in Table 1. Of these, carbon dioxide, oxygen, and hydrogen are the most important in limiting the time of submergence.

Table 1.—*Important gases occurring in submarines*

| Gas | Formula | Density. Air=1 | Dangerous concentrations (approximate) |
|---|---|---|---|
| Carbon dioxide | $CO_2$ | 1.53 | More than 5 per cent. |
| Oxygen | $O_2$ | 1.11 | Less than 14–7 per cent. Pure $O_2$ at pressure of 3–4 atmospheres may cause trouble. |
| Nitrogen | $N_2$ | .97 | Inert; dangerous only after decompression from high pressures in diving suit, etc. |
| Hydrogen | $H_2$ | .07 | Not poisonous; a mixture of about 4 per cent may be inflammable; mixtures 8–66 per cent explosive. |
| Water vapor | $H_2O$ | .62 | High humidity depressing; 100 per cent humidity, with air temperature above 100° F., dangerous. |
| Chlorine | $Cl_2$ | 2.49 | $\frac{1}{100000}$ to $\frac{1}{10000}$. |
| Arsine | $AsH_3$ | 2.70 | $\frac{1}{10000000}$ to $\frac{1}{1000000}$ on prolonged exposure. |
| Stibine | $SbH_3$ | ---------- | Supposed to be the same as arsine. |
| Gasoline | ---------- | ---------- | Mixtures of gasoline vapor 1.4–6 per cent in air are explosive; concentrated fumes cause intoxication. |
| Carbon monoxide | CO | .97 | $\frac{1}{10000}$ in several hours; $\frac{1}{100}$ in a few breaths. |

*Carbon dioxide*

Carbon dioxide is formed continually in the body as the oxygen of the air unites with the carbon of the food stores in the tissues. The volume of carbon dioxide evolved in this process is usually equal to 80 to 90 per cent of the volume of the oxygen absorbed. The gas is carried in the blood in a concentration corresponding to 5.6 per cent and the air at the bottom of the lungs contains the same amount. The expired air, which is a mixture of air from the bottom of the lungs and air from the windpipe, contains abous 4.4 per cent $CO_2$. If the percentage of $CO_2$ in the air taken into the lungs be increased, the exchange of this gas from the blood to the lungs becomes more and more difficult, and it is necessary to increase the amount of air breathed per minute (ventilation coefficient). Respiration is controlled by a center in the brain which is delicately regulated by the amount of carbon dioxide in the blood. If the percentage of this gas in the blood rise above 5.6 per cent there is an immediate response in the depth and rate of breathing until the gas has been brought down to the proper level. This is shown clearly in Chart VI, which is taken from the work of Peabody (6) in Boston.

Normal men breathed back and forth into a spirometer for a period of about 20 minutes, during which time the percentage of carbon dioxide was steadily increasing. Two per cent $CO_2$ caused a distinct rise and 4 to 5 per cent gave a ventilation coefficient of 200; in other words, doubled the amount of air breathed per minute. Beyond this point there was considerable variation in the response of different individuals. Weak men collapsed when the $CO_2$ rose to 6 per cent, strong men kept on until the air contained 7 to 9 per cent $CO_2$, but their panting was so extreme that they breathed five or six times as much air as normal. These experiments were carried on for short periods with men sitting at rest. There are few satisfactory experiments which show just how much carbon dioxide a man can breathe over a period of several hours and still survive. Probably the limit is about 6 to 8 per cent, but it may be above this. Contrary to the general belief high percentages of oxygen have but little beneficial effect in the presence of much $CO_2$.

A man sitting quietly in a chair may be able to stand high percentages of $CO_2$, but matters are different when he tries to work. In this connection we may quote Prof. J. S. Haldane (7), of Oxford, the leading authority on respiration, a man who has done much to improve the conditions in British mines and submarines.

> With 3 per cent of $CO_2$ in the air the breathing is doubled. This effect becomes just noticeable during rest, but during any exertion the effect is not merely noticeable, but very trying. During moderate work in pure air the

**breathing is three or four times what it is during rest; but when air containing 3 per cent of the $CO_2$ is breathed the increase is to six or eight times the amount of air breathed during rest in pure air. Panting is thus very severe and hinders all hard work.**

Apart from the specific effect of carbon dioxide on the respiration, this gas may cause headaches, but seems to have no other

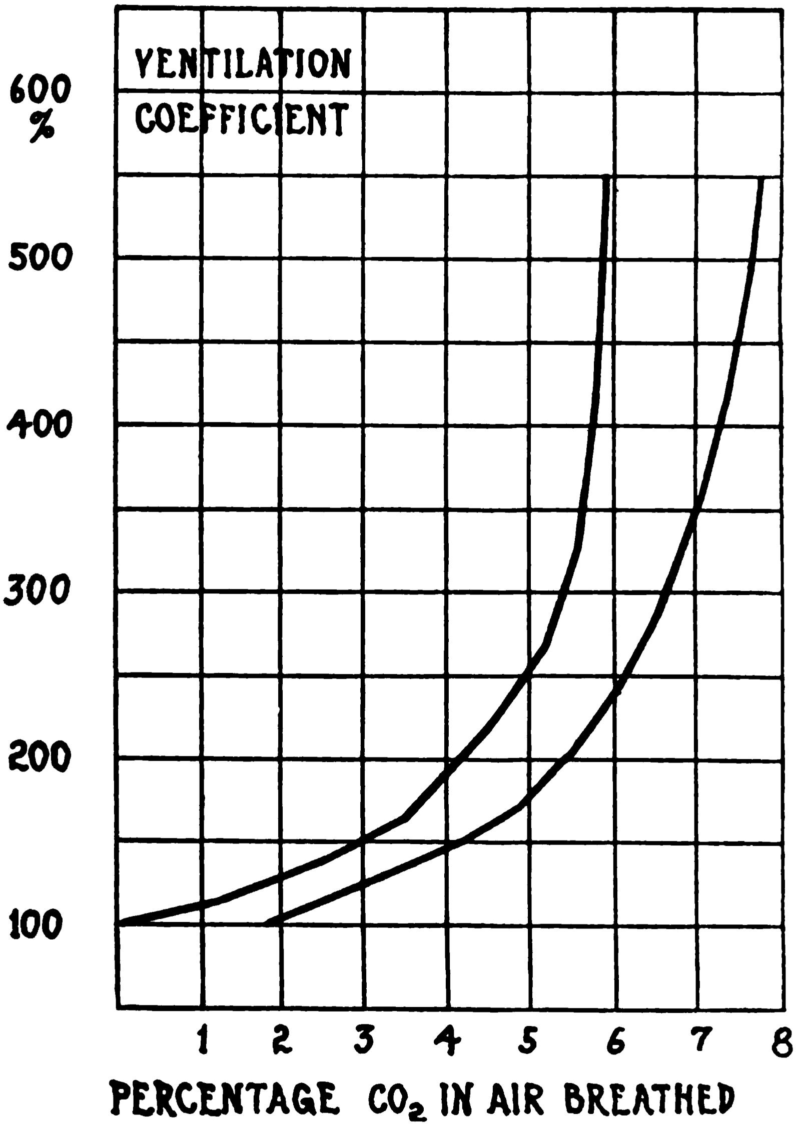


CHART VI.—Shows the effect of breathing increasing percentages of $CO_2$ on the ventilation coefficient (amount of air breathed per minute)

poisonous action. Ventilation engineers use it as an index of the pollution of the atmosphere of theaters, barracks, etc., and consider the air bad if it contains more than 0.07 per cent $CO_2$. The $CO_2$ is not to blame, but it is the heat, humidity, and body smells that cause discomfort in crowded rooms. Civilians complain of 0.07 per cent; the submarine man is lucky if he gets less than 2 per cent.

 

Carbon dioxide is somewhat heavier than air and many people have the idea that it tends to collect near the floor of a room. This is erroneous, since it mixes readily with air and the natural currents tend to equalize the percentage throughout the compartment. When a gas is once mixed with air it does not separate itself out again into layers. In a submarine, however, there is a marked tendency for the $CO_2$ to collect in crowded compartments unless there is efficient intercompartment ventilation.

In compressed air carbon dioxide will cause an increase in the depth of respiration when present in small percentages. This is because the effects are dependent on the partial pressure of the gas; that is, the actual amount in a unit of space rather than on the percentage relationship of carbon dioxide to the other constituents of the air. The same rule holds good for oxygen and is of great importance for mountain climbers and aviators.

### *Oxygen*

Oxygen is an odorless gas which constitutes 20.93 per cent of the atmosphere. Air on mountain tops contains the same percentage of oxygen as at sea level, but on account of the lowered pressure the actual amount of oxygen per unit of volume is diminished. Thus at the top of Pikes Peak, Colo., each unit of space contains 20.93 per cent of oxygen, but the actual amount of the gas corresponds to 14 per cent oxygen at 30 inches barometric pressure. The effects of low amounts of oxygen are well known. They are encountered among aviators, mountain climbers, men who have been overcome by black damp in mines, and men who have been poisoned by carbon monoxide from illuminating gas or from the products of incomplete combustion in fires in closed spaces. If an individual be exposed to an atmosphere in which the amount of oxygen is diminishing slowly, he gradually becomes acclimated by means of a physiological adaptation of his blood, circulation, and respiration to the new conditions. It is a well-known fact that men can train themselves to make high ascents on mountains by living for several days or several weeks part way up the slope. On the other hand, men exposed to a sudden diminution in oxygen will show symptoms of mountain sickness, such as weakness, dizziness, blue color, difficult respiration, vertigo, nausea, and finally collapse. These symptoms can be relieved by a return to air richer in oxygen or by the administration of oxygen from a tank. Curiously enough the symptoms are sometimes exaggerated when the subject receives oxygen and not infrequently he acts like a drunken man. It has been noted in aviators that shortly before collapse there may be a stage of exhilaration and excitement during which the movements are impulsive and judgment is erratic.

Respiration is not markedly increased until the percentage of oxygen becomes very low. This is shown by Chart VII (8), which is a record of the percentage increase in respiration of a man who was breathing the air from a tank in such a manner that the carbon dioxide was removed, but the percentage of oxygen steadily diminished during a period of 32 minutes. It will be noted that the volume of respiration was not doubled until the oxygen reached 7 per cent. This represents 14 per cent less than the oxygen contained in the tank at the beginning of the experiment. The subject did not collapse until 6 per cent was reached.

Experience at the summit of Pikes Peak, where the oxygen content of a unit of volume corresponds to 14 per cent at ordinary barometric pressures, has shown that a large number of tourists suffer from mountain sickness; others encounter no trouble unless they attempt to exercise. Still others can perform hard labor on the mountain

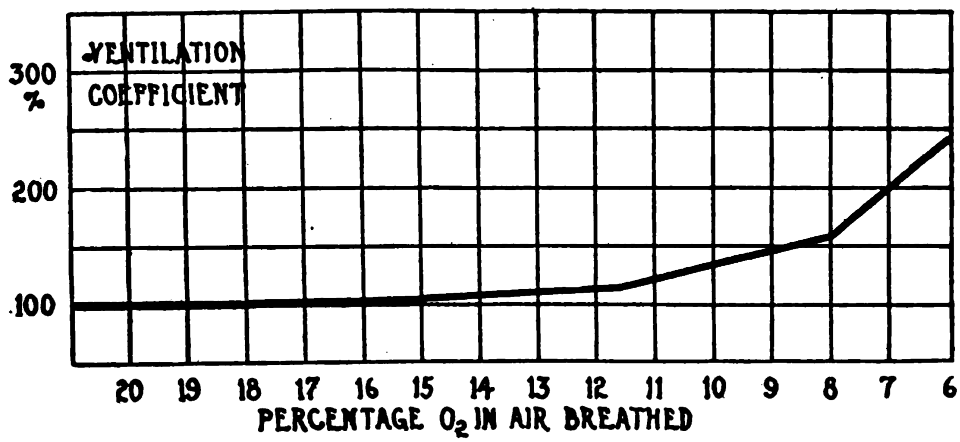


CHART VII.—Shows the effect of diminishing percentages of $O_2$ on the ventilation coefficient

summit without symptoms. This is an illustration of the wide variation of different individuals in the ability to withstand low percentages of oxygen. As a general rule the better the general physical conditions the better can low oxygen percentages be tolerated. It has been found that aviators who make repeated flights at high altitudes rapidly begin to show signs of physical and nervous exhaustion, and for this reason they are now supplied with apparatus to give them oxygen when flying at altitudes over 10,000 to 15,000 feet.

Lieut. Commander E. W. Brown, Medical Corps, United States Navy, has had a personal communication from Prof. J. S. Haldane, to the effect that he has been able to shut himself in a closed chamber and remain there in comfort during a period of 52 hours, removing the carbon dioxide by means of soda-lime. At the end of the experiment the oxygen was reduced to 9.5 per cent and Professor Haldane felt no unpleasant symptoms, but a man entering the chamber at this

time became blue and felt faint. It was the experience at the Medical Research Laboratory at the Mineola Aviation Station (8) that most aviators tested on the rebreathing tank were able to stand a reduction of the oxygen to 6 or 7 per cent during a period of half an hour before collapsing. It seems probable, therefore, that in an emergency during an enforced submergence the crew of a submarine would become gradually accustomed to decreasing amounts of oxygen and would not begin to faint until the oxygen was reduced to about 6 to 9 per cent, although some of the weaker individuals might die before this point. On the other hand, there is reason to believe that the work of the crew would become less efficient if it were the practice to allow the oxygen to fall below 17 per cent. Physical labor would be more difficult and mental effort more exhausting. Errors in judgment might be expected although the personnel would not be aware of any impairment of their mental factulties. It is for this reason that a board appointed in 1914, consisting of Naval Constructor W. McEntee and Passed Asst. Surg. E. W. Brown, United States Navy, recommended that the oxygen be not allowed to fall below 17 per cent. When there is a liberal oxygen supply on hand there is reason to believe that the nearer the percentage of this gas can be kept to normal the better will be the general condition of the crew.

Some people have the idea that high percentages of oxygen are so stimulating that they "burn up the lungs" and cause dangerous symptoms. As a matter of fact, the stimulating effect is apparent only when this gas is administered to men who have been suffering acutely from its lack. A normal man breathes almost pure oxygen without noticing its effect. Divers at extreme depths might possibly suffer from oxygen poisoning, but Leonard Hill (9) states that it is safe to breathe a mixture of 50 per cent oxygen at a depth of 70 to 100 feet for 30 to 60 minutes in a self-contained diving dress. This represents a partial pressure of oxygen much greater than can be obtained with pure gas at ordinary barometric pressures.

Pure oxygen has an extraordinary effect in increasing the length of time a man can hold his breath. If an individual breathe deeply several times to wash out the $CO_2$ and fill his lungs once or twice with pure oxygen, he can go without breathing four or five minutes. One man has held his breath nine minutes in this manner (9). This has practical application when a man has to enter a compartment filled with bad air or has to make a long dive without a suit. In case of an emergency a tank of oxygen used in this manner might support the life of a submarine crew longer than if the gas were allowed to mix with the air of the compartment. If a man can get a breath of pure oxygen every few minutes, he can stand very low percentages in the intervals.

### *Nitrogen*

Atmospheric air contains about 78 per cent nitrogen and 1 per cent argon, together with traces of several other gases. Nitrogen and argon are inert and of comparatively little interest. In deep diving, however, nitrogen is the cause of the "bends," since it enters the blood and tissues rapidly during compression and leaves the lungs slowly during decompression. Dry nitrogen in tanks has been

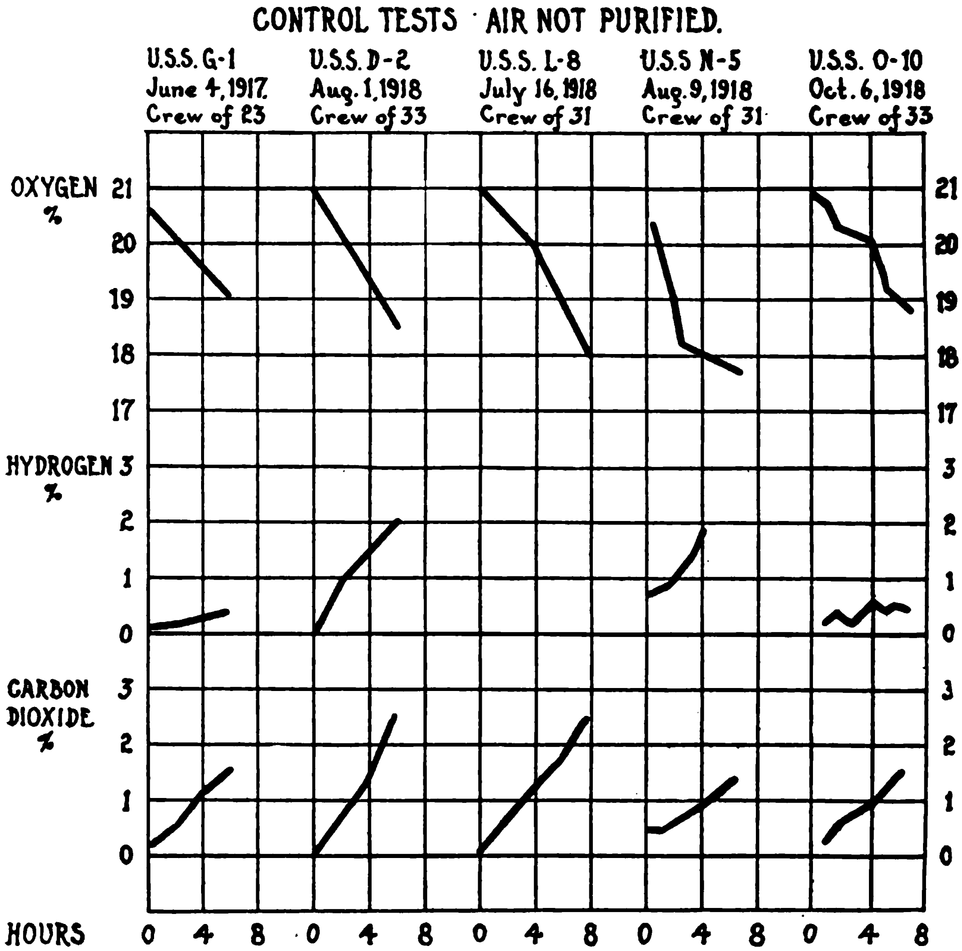


CHART VIII.—Rate of increase of $CO_2$ and $H_2$ and decrease of $O_2$ in submarines without air purification

used in submarines to clear the moisture from periscopes. This gas has no specific action but merely takes up water as would any other dry gas. The escape of nitrogen into the interior of the boat dilutes the good air to a slight extent, but has no other harmful effect.

### *Hydrogen*

Hydrogen, like nitrogen and argon, is inert, so far as the human body is concerned, but it is far from inert when exploded. Such explosions may occur in submarines, but, fortunately, the mixture seldom reaches the percentages which give the maximum destruc-

tive force. When hydrogen is burned 2 parts of this gas unite with 1 part of oxygen to form water. In the process, a large amount of heat is generated, since hydrogen per unit of weight has a higher caloric value than any other fuel. Hydrogen is also the lightest of all gases, having a specific gravity of 0.07 as compared with air, and consequently is the most diffusible of all gases. An explosion started in a proper mixture travels with incredible rapidity, passing through the wire mesh of a Davy lamp and other baffles which serve to prevent the propagation of an explosion of marsh gas in coal mines.

It is generally considered that a mixture of 4.1 per cent is inflammable and 8 per cent is explosive, but authorities differ.

Hydrogen is liberated from the storage batteries of submarines in increasing amounts as the batteries are charged, and the formation of this gas is very considerable when high specific gravities are reached and during the period of an overcharge. For a short time after the charge has ceased the evolution of hydrogen continues on account of the release of bubbles of gas which have attached themselves to the plates. When the batteries are idle there is slight gassing and during the discharge, as a rule, there is very little formation of the gas. While the above statements hold in general there are exceptions, and those who make analyses are often surprised to find that more gas is formed than would be expected. For instance it will be seen from Charts III, IV, V, and VIII that there was a considerable accumulation of hydrogen in the submarine during a period of discharge.

The Bureau of Steam Engineering and the Bureau of Construction and Repair make every effort to provide sufficient ventilation of the batteries to keep the hydrogen in the battery cells and battery ducts below 2 per cent. As a general rule, the mixture leaving the ducts is well within these limits. Dangerous mixtures are occasionally found. This may be the result of excessive gassing of some of the cells or of inefficiency on the part of the blowers which may be damaged by droplets of sulphuric acid carried in the ventilating current.

The presence of an undesirable amount of hydrogen in the battery duct may be discovered in a few minutes by making an air analysis (10) or it may be announced more emphatically by a battery explosion. High percentages sometimes occur within the living compartments of the boat during inboard battery ventilation.

### *Water vapor*

During long submergences or repeated short ones the humidity of the atmosphere becomes depressing and the constant drip of water from all cold objects is annoying. While the water vapor can not

be called poisonous, it is a greater nuisance than all the other gases put together and it is well worth while to consider its formation in detail.

The humidity of the atmosphere results from the constant evaporation of water from the skin and lungs of the crew. A man lying in bed at rest and in a comfortable atmosphere loses from his skin and lungs about 1 ounce of water an hour (11). When he is working he loses several times this amount. Football players on a hot day may lose 5 to 10 pounds of water during a game. While it is difficult to obtain anything like exact figures, we may estimate that the crew of a submarine gives off 60 to 100 pounds of water a day. In addition to this there is a considerable amount of water from the batteries and from the cooking of foods.

The percentage of humidity within the boat after it has been submerged for a few hours depends on the relationship of the temperature of the air with the temperature of the coldest object exposed to the air. This is due to the fact that air saturated with moisture at one temperature will, if cooled, deposit all water vapor in excess of the amount which it can hold at the new temperature. By consulting Table 2 (12) we can see that air saturated with water vapor at 80° F. will contain 10.9 grains per cubic foot, but when saturated at 60° will hold only 5.7 grains. In other words; if we take air saturated at 80° F., cool it to 60°, and heat it again to 80°, we have reduced the humidity to 53 per cent. In a four-day submergence the average temperature was about 75° F. and the average humidity about 85 per cent, the air containing about 8 grains of water vapor per cubic foot. This corresponds to saturation at 70° F., and we can assume that the air in the immediate neighborhood of the cold parts of the submarine had this temperature. One of the most efficient means of removing water vapors from air is to pass it over pipes filled with cold brine.

TABLE 2.—*Weight in grains of the aqueous vapor contained in a cubic foot of air*

| Temperature, °F. | Percentage of saturation | | | |
|---|---|---|---|---|
| | 40 | 60 | 80 | 100 |
| 30 | 0.77 | 1.16 | 1.55 | 1.94 |
| 40 | 1.14 | 1.71 | 2.28 | 2.85 |
| 50 | 1.63 | 2.45 | 3.26 | 4.08 |
| 60 | 2.30 | 3.45 | 4.60 | 5.75 |
| 70 | 3.19 | 4.79 | 6.38 | 7.98 |
| 80 | 4.37 | 6.56 | 8.75 | 10.93 |
| 90 | 5.92 | 8.87 | 11.83 | 14.79 |
| 100 | 7.91 | 11.86 | 15.81 | 19.77 |

Excessive humidity may be dangerous in the Tropics. In temperate climates the body loses about three-quarters of the heat produced

by means of radiation and conduction and one-quarter through the evaporation of water. When the temperature of the surrounding air rises above that of the body, 98° to 99° F., it is obvious that radiation and conduction of heat from the body must cease and the evaporation of water becomes the only means of heat removal. Evaporation, however, also ceases when the humidity reaches 100, and the temperature of the body must rise to a fever level, since it is impossible to stop the constant production of heat within the body cells.

Jones and Mankin (4) found the wet KATA thermometer of Leonard Hill gave the best indication of comfort conditions during submergences in the Tropics. They concluded that most of the discomforts during these submergences were due to the physical changes in the air and not the chemical changes. They recommended certain improvements in the main ventilating system and believed that it was advisable, if the military efficiency of the boat would not be hampered, to install a cooling and drying system in the forward and after battery compartments.

### *Chlorine*

The sodium chloride molecule may be broken up with the liberation of the chlorine gas by the action of concentrated sulphuric acid or by electrolysis. It it said that chlorine is formed when salt water merely short-circuits the battery terminals, but the usual source of this gas in submarines is the accidental presence of sea water within the battery cells. In spite of many precautions this occurrence is by no means uncommon. An accident of somewhat unusual type is described below:

On September 12, 1914, off Newport, R. I., chlorine gas was noticed in the battery discharge of the U. S. submarine *E-2* after she had been running submerged for a period of 40 minutes, and when she was at a depth of 50 feet. Immediately the gas became so strong that all hands were affected, and the pressure in the boat forced the aneroid barometer pointer off the scale. The boat was brought to the surface and by the time the conning tower could be safely opened (about four minutes after chlorine was first noticed) the gas had become extremely irritating to the throat and lungs, seriously affecting the power of speech and embarrassing respiration. The immediate after effects on the personnel were violent coughing spasms, vomiting, and in one instance slight hemorrhage (source of hemorrhage unknown). In several of the men the throat and lung irritation continued for several days.

A hole 1 inch square was found in the steel plating of the middle main ballast tank (result of electrolysis) and a crack in the lead lining of the forward battery tank. Salt water was admitted to the battery cells, and, in its electrolysis, chlorine was formed.

Cholorine was used in large quantities during the Great War, and we have learned much about its properties. On account of its high specific gravity, 2.45 as compared with air, it remains near

the ground and diffuses slowly into the surrounding atmosphere unless stirred by currents of air. It is highly toxic, being appreciable in concentration of 1 part in a million, dangerous if breathed in concentration of 10 parts in a million for half an hour, and very dangerous in concentration of 100 parts per million if breathed for a few minutes. The gas acts as an irritant to the respiratory passages, producing irritation of the throat, pain in the chest, and oozing of the fluid into the lungs. Concentrations of the gas which are not strong enough to start men coughing as a rule cause no serious effects, but experience on the battle front has taught men to put on their gas masks as soon as they recognize its pungent smell.

### *Sulphuric acid*

Sulphuric acid smells like chlorine and may direct false suspicions toward the battery exhaust. The acid is said to be nonvolatile and it is believed that it is carried up into the air ducts in the form of tiny envelopes of electrolyte surrounding bubbles of hydrogen. For this reason the smell is strongest when the batteries are gassing freely, and some men estimate the concentrations of hydrogen by the strength of the smell of sulphuric acid. This is an indirect method, since hydrogen itself has no smell.

The choking sensation derived from sulphuric-acid spray is not dangerous but is annoying. The acid can be removed from the air by any system of baffling which causes the bubbles to strike a solid substance and break up. If necessary, a layer of cracked pumice stone or marble might be placed over a battery duct, but such an obstacle would lead to a serious diminution in the battery ventilation if applied at a time when the batteries were gassing freely.

### *Arsine*

During the war a few cases of arsine poisoning developed on some of the British, French, and Italian submarines. These were traced to the presence of arsenic in the battery grids, separators, or electrolyte. The well-known Marsh test, which detects minute traces of arsenic, is based on the fact that arsine is readily formed by the action of nascent (freshly generated) hydrogen on arsenic in the presence of acid. It will be seen that these conditions are found in storage batteries and we would expect that any arsenic in the cell would be liberated in the first few cycles. As a matter of fact, the gas seems to be given off very slowly and the British had most of their trouble with old batteries.

Arsine is a cumulative poison, since it is eliminated from the body very slowly, as a rule more slowly than it is absorbed. A French commission was of the opinion that the gas is harmless when present in 1

part in 1,000,000,000, but is distinctly deleterious to health when present in concentration of 1 part in 10,000,000. The gas in low concentrations is odorless and its effects are rather slowly felt. At first the symptoms are mild and men merely feel loss of appetite, nausea, slight weakness, and perhaps headache. Later they develop more severe symptoms, such as vomiting, diarrhea, jaundice, and exhaustion. The poison acts chiefly on the blood and as a rule recovery is slow when the symptoms have been marked.

Tests made on U. S. submarine *L-8* and several *N* boats in 1918 with mercuric bromide paper gave colorations which corresponded roughly to 1 part arsine in 20,000,000. This was traced to the presence of considerable amounts of arsenic contaminating the antimony in the battery grids. No cases of arsenic poisoning were found, but it is necessary to remember this possible source of trouble on the submarines. The test for arsine and stibine is very simple.[4]

### *Stibine*

Stibine, antimonietted hydrogen, resembles arsine closely and is believed to be almost as poisonous, but it is less easily formed and more easily destroyed. Apparently it causes no trouble in submarines, but it may possibly be present in amounts sufficient to deepen the color of the arsine test papers. In this case its poisonous effects would be added to those of arsine and the significance of a strong arsine test would not be changed.

### *Gasoline fumes*

In some of the older submarines with gasoline engines there were numerous cases of gasoline poisoning due to the inhalation of concentrated fumes. Such "gasoline jags" resemble acute alcoholic intoxication and they may be insidious in their onset. They have occurred occasionally in recent years when men have worked with gasoline in closed compartments.

### *Carbon monoxide*

This gas results from the incomplete combustion of any kind of fuel and is a constituent of the exhaust gases of engines. It is also found after fires in closed apartments where there is an insufficient supply of oxygen. The gas, even if present in concentrations of 1 part in 10,000, combines with the blood to form a stable compound

[4] Strips of Swedish filter paper are dipped in a 3 per cent mercuric chloride solution, hung up and dried in air-free gas fumes, and kept in clean bottles. The test is made by exposing a small strip of this paper for an hour or so in the atmosphere to be tested. A positive reaction to arsine is shown by a color change varying from a light yellow to orange to brown, according to the quantity of arsine present. Mercuric bromide paper prepared in a similar manner is even more sensitive.

which will no longer carry oxygen to the tissues. Men poisoned with carbon monoxide therefore show symptoms very similar to those encountered in low percentages of oxygen. They become excited and even maniacal, and curiously enough these symptoms may be temporarily increased when the patients are removed to fresh air. Carbon monoxide is particularly dangerous because it is odorless and those exposed to it are often unconscious of any ill effects until they collapse. Small animals such as mice and canaries succumb to carbon monoxide more rapidly than men, because they breathe faster. The volume of air entering their lungs per minute is very large in proportion to their weight and this causes a more thorough exposure of the blood to the poison. Miners in dangerous galleries carry mice or canaries in cages and watch them carefully to note signs of drooping and unconsciousness. If the presence of this gas is suspected in a compartment no one should enter unless wearing rescue apparatus.

### *Odors in submarines*

A sensitive nose can detect a large variety of smells when entering a submarine that has been poorly ventilated. The engine room contributes the smell of fuel and lubricating oils and occasionally a trace of exhaust gases. The head gives its characteristic odor unless it is kept particularly clean and well flushed. The galley stove is the source of many smells, onions and cabbage being the chief offenders. The frying of foods may be the cause of much annoyance, since fat can be broken up by heat into gaseous products which are not only irritating to the eyes and throat, but are in addition somewhat poisonous. Garbage breeds smells rapidly and may be most offensive if not kept in tightly covered cans.

Perhaps the most disagreeable odor is the body smell found in the living compartments. This is largely dependent on the cleanliness of body and clothing, but there is a large variation between individuals of the same race and habits. Some men suffer all their lives from a disease known as " bromidrosis," " stinking sweat." (Perhaps it would be more accurate to say that their neighbors do the suffering.) This disease may be confined to the feet. If present to any marked degree such a man would seem to be unfitted for submarine duty. Similarly a man with bad breath due to chronic colds or dirty teeth is an undesirable shipmate.

Some scientists have believed that there is an unknown poisonous substance given off by the body which affects the health of persons in crowded quarters. They have tried repeatedly to demonstrate its presence, but have not yet succeeded. It is generally admitted that the discomfort of crowded rooms is largely due to the warmth and humidity, but we must not forget the psychic effect of bad smells.

## IV. Apparatus for Testing the Air in Submarines

Air purification in submarines will always remain a matter of guesswork unless actual tests are made to determine the percentages of the various gases present. The only hope of improving conditions depends on air analyses, but it is difficult to demonstrate to the submarine personnel the fact that air tests in the long run save time and trouble. Submarines are filled with apparatus and everyone with a hobby wants to put some new instrument on board. Officers and men work hard under adverse conditions and suffer from the continual strain of a wretched environment. Much of this can be relieved by proper air purification directed by a few tests. Elaborate apparatus has no place in a submersible and it is necessary to use devices which are rugged, simple, and rapid. Much hard labor has been devoted to the development of such apparatus.

### *Tests for hydrogen*

Most of the tests for hydrogen depend on the fact that the gas will be oxidized completely and form water in the presence of a white hot wire or a catalytic agent, such as palladium black. Two atoms of hydrogen unite with one of oxygen and the resulting water vapor condenses causing a diminution in volume. Exactly two-thirds of this diminution is due to hydrogen.

The simplest and probably the best apparatus for use in submarines is the Burrell hydrogen detector which is being furnished to our boats (13). It was developed originally by Mr. George A. Burrell, of the Bureau of Mines, for use in underground passages where marsh gas often causes explosions. The instrument is used by common miners, who appreciate the fact that it warns them of dangerous mixtures. An analysis of the air can be made in about three minutes. First a sample of air is taken into the tube and the valve closed. Next a platinum filament is heated by means of a battery and kept white hot for exactly two minutes. Most of the hydrogen is burned in the first few seconds but it requires the full time to remove the last traces. The instrument is then shaken to equalize the temperature and the percentage of hydrogen read off on the scale. Exact directions for the use of the Burrell detector will be found in article 2704, Chapter XXVII of the Manual of the Bureau of Construction and Repair (13). In this same chapter are given the directions for the use of air purifying apparatus and of compressed air in submarines, and also the method for analyzing the carbon dioxide in the air.

There are several automatic devices for the detection of inflammable gases but most of them seem to be too delicate to stand the

rigors of service conditions on board the submarines. The palladized asbestos hydrogen eliminators described in another place can be used as a very rough method of estimating the percentage of hydrogen in the air, since they become too hot to touch in a mixture of 2 per cent hydrogen. It is not safe, however, to rely on this material because the eliminators may become inactive without warning. Catalysts are sometimes "poisoned" by such substances as arsine, grease, or other forms of dirt.

*Estimation of carbon dioxide*

The Orsat apparatus, familiar to all who have studied steam engineering, is an excellent device to determine the percentage of carbon dioxide and oxygen in air. It has the disadvantage of being bulky, fragile, and rather clumsy for use in submarines. In modified form it has been used in the German and French submersibles.

Higgins and Marriott (14) have devised an extremely simple test for carbon dioxide, which can be made in about a minute and a half. A sample of air is pumped into a rubber bag and then bubbled through a solution containing bicarbonate of soda and a purple dye which turns bright yellow when acid. After about 30 seconds the alkaline bicarbonate and the acid $CO_2$ of the air strike a balance, which is not changed no matter how much more of the same sample is blown through the solution. This balance develops a certain tint of color between purple and yellow, and this is readily matched on a scale giving the percentage of carbon dioxide. The analysis can be made by any member of the crew and is accurate enough for all practical purposes. On one submergence in a series of 71 analyses the average divergence between this apparatus and an Orsat was only 0.17 per cent $CO_2$.[5]

Canaries and mice respond to increased carbon dioxide in very much the same manner as men and are of little service as test objects.

*Estimation of oxygen*

At present there is no test for oxygen applicable for use on submarines simpler than the Orsat. Professor Haldane has devised a flame test for use in nonfiery mines, but its use would not be advisable in submarines unless a careful analysis of the air had proved that there was no danger from an explosive mixture of hydrogen. In some boats where smoking is permitted men notice after a few hours' submergence that matches will not burn. This indicates a reduction of the oxygen to 16 to 18 per cent, but the test is some-

[5] For directions as to the use of the Higgins and Marriott testing outfit see art. 2703, Ch. XXVII, C. and R. Manual (13).

what invalidated by dampness and the wretched quality of matches in war time. The phosphorous head of the match should ignite in the presence of low amounts of oxygen, but the wood will not burn unless there is a sufficient amount of this gas. Contrary to the general belief, carbon dioxide in high percentages has little effect in extinguishing a flame. The following table is taken from a bulletin on black damp in mines by Burrell, Robertson, and Oberfell (15). The tests were made by burning different substances in a chamber until the oxygen was reduced so low that the flame was extinguished. It must be remembered that this was in quiet air and that slight drafts will blow out a flame when the oxygen is low.

| Nature of flame | Residual air | |
|---|---|---|
| | $O_2$ | $CO_2$ |
| Candle in pure air | 16.39 | 2.95 |
| Candle in 3.2 per cent $CO_2$ | 16.68 | 6.51 |
| Candle in 13.5 per cent $CO_2$ | 17.39 | 16.00 |
| Kerosene, average | 16.6 | 3.00 |
| Gasoline | 15.5 | ---------- |
| Alcohol | 14.9 | 4.30 |
| Acetylene | 11.7 | 6.30 |
| Hydrogen, average | 6.5 | ---------- |

With regard to the feasibility of the use of small animals to indicate a dangerous diminution in the oxygen content of the air, it is to be noted that they do not show signs of decreasing oxygen earlier than human beings.

### *Tests for arsenic and arsine*

The best test for arsenic in electrolyte or plates is the Gutzeit method or some of its modifications. The material to be tested is treated with acid and arsenic-free zinc, thus generating nascent hydrogen and arsine. The gas rises through a tube in which is placed a small strip of filter paper impregnated with mercuric chloride or mercuric bromide. Arsine darkens the lower portion of the strip of filter paper and the amount present in the sample can be estimated by comparing the paper with the set of standards. Sulphuretted hydrogen ($H_2S$) interferes slightly with this test, but can be removed by lead acetate. Stibine ($SbH_3$, antimoniureted hydrogen) gives a darker color than arsine and is difficult to separate from this gas. The test papers are made by soaking filter paper in a solution of mercuric chloride or mercuric bromide, the latter being the more delicate of the two. When exposed to diluted concentrations of arsine the mercuric chloride paper turns first light brown, then dark brown, and then black. Mercuric bromide paper turns first light yellow, then orange, then russet.

### *Estimation of gasoline vapor*

The Burrell hydrogen detector can be used for any inflammable gas but, of course, a different scale is required for each substance. If used for gasoline vapor a reading of 2.5 per cent on the hydrogen scale would indicate 0.5 per cent gasoline vapor. Five per cent on the hydrogen scale indicates about 1 per cent gasoline in the sample.

## V. Methods of Air Purification[6]

### *Methods of removing carbon dioxide*

There are many methods of removing carbon dioxide from the air and several different reagents have been put to practical use in submarine air purification. Carbon dioxide being a weak acid is readily absorbed by hydroxides such as caustic soda (NaOH), caustic potash (KOH) or slaked lime ($CaO_2H_2$). When dry caustic soda or caustic potash is exposed to air containing carbon dioxide, carbonate is formed on the surface of the granules and the deeper portions are unchanged so that the theoretical chemical efficiency of these alkalies is never attained. When in solution the results are better, but there is the disadvantage of the added weight of the water. Potassium hydroxide in solution is highly efficient; sodium hydroxide on usage tends to clog the apparatus. Both of these alkalies are caustic and somewhat dangerous to handle. They have been, however, used apparently with considerable success in German, French, and Italian submarines, either in solution or in flat cakes.

Sodium peroxide ($Na_2O_2$, oxylithe) has been used for submarines and for rescue apparatus. This substance, when dissolved in water, liberates oxygen, leaving a strong solution of sodium hydroxide, which, in turn, is available for the absorption of carbon dioxide. Theoretically, such a substance is ideal for use in submarine ventilation but it has several disadvantages. In this country it is expensive and difficult to obtain. It is strongly caustic and liable to burn those who handle it. Under certain conditions it forms oxygen so rapidly that there is danger of starting a fire.

The most satisfactory substance for the removal of carbon dioxide is a mixture known as soda-lime. This has been used for many years but its efficiency was improved by Professor Haldane, who found that the best results were obtained if he used a mixture of 96 per cent calcium hydroxide and 4 per cent sodium hydroxide, calculated on the basis of dry weight. The substance is manufactured by spreading a thin layer of unslaked lime on a cement floor and sprinkling it with a solution of caustic soda, raking it until a moist,

[6] For detailed instructions see arts. 2700–2702, Ch. XXVII, C. and R. Manual (13).

somewhat floury mixture is obtained. This was used in trays in a box through which the air was driven by means of a small blower. The results obtained by this Haldane apparatus in British submarines were satisfactory. In this country the same mixture of soda-lime was at first used in a new container devised by Prof. W. E. Gibbs, of the Bureau of Mines. This consists of a can 14 inches high, 12 inches in diameter, with a dome-shaped screen in the bottom covered by a 12 to 13 inch layer of soda-lime. When needed for use the top is removed, a small slip cover taken off the bottom of the can and the soda-lime in its container placed on top of a small blower. When the carbon dioxide is absorbed water is given off according to the reaction $2NaOH+CO_2=Na_2CO_3+H_2O$. Heat is also developed by the reaction. A few minutes after starting the blower the air leaving the can becomes warm and moist and remains so until the reagent is exhausted.

This apparatus gave satisfactory results when tested near the place where the soda-lime was manufactured, but difficulties were encountered when the material was transported. The soda-lime is so soft that it tends to pack into a solid, doughy mass, especially if it be a little too moist. Through such a mass it is almost impossible to drive air by means of the blower since this can only develop a pressure equal to a column of water 2 to 3 inches high. The diminution in the flow of air through a soda-lime can caused by jolting is shown in the following table:

| Condition of can | Flow of air through can per minute |
|---|---|
| | *Cubic feet.* |
| Empty cans | 206 |
| Soda lime sifted into can | 31 |
| After dropping can 5 times on the ground from a height of 6 inches | 7 |
| After dropping 10 times | 2 |
| Same soda lime raked and sifted back into can | 27 |

It was also found that the weight of the heavy mass of soda lime flattened out the dome-shaped wire screen and caused the air to channel through the center of the can, leaving untouched the soda lime near the periphery. In order to obtain satisfactory results from such a can it is necessary to dump out all the soda lime and reshape the dome, scraping off the material which clogs its meshes. Next the mass of soda lime must be broken up by a rake or some similar instrument and sifted back into the can. Two blowers with cans treated in this manner will as a rule take care of all the carbon dioxide given off by a crew of 30 men and will last about three or four hours. As soon as a blower is started with a new can it is necessary to make a rough test of the amount of air passing through

the lime. The current should be sufficient to raise a handkerchief into a dome about 2 inches higher than the rim of the can.

The unsatisfactory physical properties of this type of soda lime led to an effort to find a preparation which would not pack into a solid mass. Since 1916 soda-lime granules have been used in the canisters of gas masks and a large amount of experimentation has been done in an effort to produce hard granules which will not obstruct the flow of air through the masks. The problem of adapting these for use in submarines was taken up by Maj. R. E. Wilson, C. W. S., U. S. A. A large number of preparations of soda-lime granules were made at the Astoria Plant of the gas defense division, Chemical Warfare Service, and were tested for several important properties. Hardness was determined by rolling the granules with steel balls. Chemical efficiency was tested by running a mixture of 2 per cent $CO_2$ through a layer of the material and determining first the activity of the soda lime and second its total capacity. The activity represents speed with which it removes $CO_2$; the capacity is the total amount which can be removed per gram of substance. Table 3 shows the results obtained with the more important mixtures tested.

TABLE 3.—*Results obtained by Chemical Warfare Service, U. S. Army, in testing various absorbents for carbon dioxide*

| Type of absorbent | Grams $CO_2$ absorbed by 1 gram of absorbent | Comparative hardness of granules |
|---|---|---|
| Gas-mask soda-lime regular Astoria granules | 0.050 | Above 95. |
| Lime, caustic soda, kieselguhr | .072 | |
| Charcoal with NaOH or KOH | .07 | |
| Pumice with NaOH or KOH | .02 | |
| Fused caustic with charcoal | .10 | |
| Caustic soda granules as used in rescue apparatus | 0.10–.13 | |
| Old Navy soda-lime (maximum) | .312 | Too soft to screen. |
| Old Navy soda-lime (average) | .294 | |
| Lime and caustic soda: | | |
| 3 per cent NaOH (13–16 per cent moisture) | .225 | 69.2. |
| 4 per cent NaOH | .310 | 65.4. |
| 8 per cent NaOH | .273 | 74.4. |
| 13 per cent NaOH | .095 | Could not be screened. |
| 4 per cent NaOH (varying moisture content). | | |
| 7.5 per cent moisture | .199 | 89.0. |
| 13.9 per cent moisture | .310 | 65.4. |
| 17.5 per cent moisture | .332 | 85.8. |
| 24.1 per cent moisture | .283 | 59.4. |
| 20 per cent solution NaOH in water (100 per cent efficiency assumed).[1] | .11 | Liquid. |
| 20 per cent solution KOH (100 per cent efficiency assumed).[1] | .08 | Do. |

[1] In test with Servus B Apparatus, using 21 per cent NaOH, only 43 per cent efficiency was obtained.

It will be seen that a mixture containing 96 per cent lime, 4 per cent NaOH, calculated on a dry basis, made up with 14 per cent moisture, has satisfactory hardness, high activity, and a distinctly higher capacity than any of the other substances. This material is prepared in large quantity, as follows:

Ground-slaked lime is treated with a solution of caustic soda and made into a doughy "wet mix," which is spread on trays about 2 inches deep. These are placed in a closed room and allowed to set for several days, forming hard cakes. The cakes are dried for several days and the water content brought to 14 per cent by spraying. They are then ground and sifted to a 8 to 14 mesh. This means that the granules will go through a screen with 8 wires to the inch and will be stopped by one with 14 wires to the inch. This soda-lime is filled in cans 14 inches deep, 12 inches in diameter, at the navy yard. The screen arrangement at the bottom has been modified so that there is no longer danger of its being crushed flat. The first batch of this material, although through an error in manufacture it was not up to the standard, gave satisfactory results in the four-day submergence of the U. S. submarine *O-10*. The slight amount of dust which came off the soda-lime was readily caught by placing two layers of cheesecloth over the top of the can.

Major Wilson has calculated that there are at least 10 different factors which enter into the problem of designing a soda-lime container of the maximum efficiency. From a consideration of these he has suggested a can similar to the one now in use, but measuring 15 inches in diameter, 10½ inches high, with a 9-inch layer of absorbent. The screen at the bottom is flat, with a perforated baffle to counteract the tendency of the air to flow through the central portion of the absorbent. Soda-lime of 8 to 14 mesh is packed firmly in this and covered with a wire screen to prevent shifting of the contents, with consequent formation of dust. It has been estimated that one such can would allow a flow of 50 cubic feet of air per minute, and with a crew of 30 men, if started when the $CO_2$ had reached 1 per cent, would keep it at about this level for 5½ hours.

When the soda-lime is in granular form it seems to be difficult for the $CO_2$ to reach the centers of even these small granules. After the material in the cans has been apparently exhausted it will absorb almost half as much again $CO_2$ if crushed to a powder and stirred so as to expose all of the material to the air (5). Powdered soda-lime can not be used in a can on top of a blower, but it can be spread in trays or on the deck in case of necessity. The writer, in 1918, while making the test on hydrogen released inside of a diving lock shown in Chart II, found that the $CO_2$ was increasing rapidly because the old soft type of soda-lime had packed so tightly in the tin canister that the air could not be driven through it by the Sturtevant blower. Some newspapers were then spread on the flooring of the diving lock and the soda-lime was spread over them in a thin layer. For the remaining part of the 28 hours this simple device absorbed all the $CO_2$ given off by two men. Barach, in his latest form of pneumonia oxygen chamber, removes the $CO_2$ by means of a tray containing

a layer of Navy soda-lime placed under the patient's bed. The air is kept in motion by means of a cooling coil at one end of the pneumonia chamber. The cold air drops to the bottom of the chamber in the neighborhood of this coil and rises at the other end, thus securing a surprisingly efficient movement of air.

### *Methods of supplying oxygen*

Oxygen is available at all navy yards in strong containers holding about 200 cubic feet, compressed to 1,800 pounds. When used in submarines, a reducing valve with gauge is attached and the oxygen released gradually. One precaution must always be taken. No oil or grease should be used in the gauge or fittings or a dangerous explosion may result.

Liquid oxygen is now a commercial article, and it may perhaps be of service in submarine ventilation. It resembles liquid air, boiling at a temperature of $-181.5°$ C. Like liquid air it must be transported in open containers, since there is always an evaporation from the surface which keeps the remainder of the liquid cool. If the container be closed, a tremendous pressure develops. If spilled on the ground, the liquid oxygen runs about in little drops like water poured on a red-hot stove, evaporating rapidly. At such a time, if it comes in contact with inflammable material in the presence of spark or flame, a fire or explosion may result, as combustion is rapid in high concentrations of oxygen.

### *Renewal of air from flasks*

Submarines carry, compressed in flasks, an amount of air equal to several times the free-air space of the boat. When the air of a submarine has been vitiated, some of it may be pumped overboard or compressed into a "dirty" flask and an equal amount of pure air liberated. Such a method has a few disadvantages. The alternate reduction and increase of barometric pressure is uncomfortable to the ears and the air released from the flasks smells of oil. The percentage efficiency of this method on one test was about 78 per cent on account of the fact that it is possible to change only a small part of the air each time. Good air is continually being mixed with bad. It is just as if you took a bucket of inky water and tried to remove the ink by first dipping out a glassful of the mixture and then adding an equal amount of clean water. The larger the proportion removed each time the better the results, but in a submarine it may not be considered advisable to cause large variations in the barometric pressure. The ordinary aneroid might be injured, great reductions might lead to symptoms of oxygen want, and large increases would accentuate the symptoms referable to $CO_2$.

Theoretically a fairly high efficiency could be obtained if the intercompartment ventilation were stopped, blankets hung in the passageways to act as crude valves, and the air admitted slowly at one end of the boat while it was pumped out of the other end. Air coming from the banks could probably be freed from objectionable odors by using gas-mask charcoal. In fact, the whole procedure seems capable of improvement, but experimental evidence is scanty.

### *Hydrogen elimination*

Hydrogen has caused so much apprehension that it is desirable to have some form of apparatus which will remove it from the interior of submarines. It is possible to reduce the percentage of hydrogen by burning it in small blue flashes when switches are opened or closed. This is a dangerous practice, as there is only a narrow margin between the percentage which permits the propagation of flame and the percentage which causes an explosion. In the same manner it is hardly safe to burn out hydrogen by means of glowing platinum wires, even though these be protected by screens of gauze, porcelain, alundum, etc. Philips and Steele devised for the British Admiralty a hydrogen eliminator, consisting of layers of palladized asbestos warmed by ordinary electric light bulbs. These can be screwed in sockets in the submarine, and it seems probable that a few dozen will take care of all the hydrogen evolved during the battery discharge.

The Bureau of Medicine and Surgery developed a modification of this type of eliminator, consisting of palladized asbestos spread on the surface of an electric light globe or attached to any other inert object. These eliminators, when exposed to an atmosphere containing more than 1.5 per cent hydrogen, gradually warm themselves and in an atmosphere of 2 per cent hydrogen become too hot to touch. In a very high percentage little sparks can be seen to run over the surface, and these may start an explosion. This is on account of the active oxidation produced, catalytically, by the palladium black precipitated on the asbestos. The catalyst combines hydrogen and oxygen to form water and is never used up in the process. In practice 24 of these lamps are screwed into sockets in a wooden box 8 by 5 by 5 inches. No electrical connection is needed. A bank of 12 eliminators when tested in an airtight diving lock at the Navy Yard, New York, oxidized hydrogen at the rate of 1 cubic foot per hour in a mixture which averaged about 1.2 per cent hydrogen. (Chart II.) Another eliminator of 25 units was carried on three or four patrol cruises from the submarine base, New London. The results obtained on the U. S. submarine *N–5*, are shown in Charts III and IV. In a prolonged submergence on the U. S. submarine *O–10* this same eliminator was exposed to 1.7 per cent hydrogen, but only 2 out of 25

lamps became hot. The others did not apparently oxidize enough hydrogen to make them warm. Curiously enough, when tested a month later at the Naval Medical School in a slightly richer mixture of hydrogen, 19 of the 25 lamps had recovered their function. This illustrates the variation in the activity of catalysts.

On the submergence of the U. S. submarine *O-10*, it was found that the hydrogen in the submarine was diminished by 2 new eliminators of 24 lamps each, supplemented by the 2 active lamps of the old eliminator. This is represented graphically in Chart V. When checked up frequently with determinations made by the Burrell instrument, it is possible to use the hydrogen eliminators as a rough form of hydrogen detector, since they become too hot to touch when the mixture is over 2 per cent.

### *Reduction of humidity*

Moisture can be removed from a current of air by passing it through concentrated sulphuric acid or over calcium chloride. These reagents are so heavy that it is impractical to use them in submarines. Another method which is highly efficient is to cool the air by blowing it over brine coils. As was shown in Table 4, it requires only a slight reduction in temperature to remove half the water vapor from the air. By means of heat interchangers it is possible to transfer the heat of the air entering such an apparatus to the cold air leaving the brine coils. This makes for economy of refrigeration and in cold weather lessens the amount of artificial heat required. The brine coils would also act as a distillation outfit and would provide daily 50 to 100 pounds of water pure enough for washing and perhaps for drinking or for batteries. This might save the weight and space of a water tank. Theoretically in a long submergence it would be possible to recover from the air all the water of the food and drink consumed by the crew with the exception of the small proportion passed off in the urine.

Such an elaborate apparatus has never been tested on our submarines but a similar effect has been secured in other ways. Air has been blown over cold metal parts by means of electric fans. In some of the boats the pipes for intercompartment ventilation run outboard under the superstructure and are much colder than the interior of the submarine (5). In the four-day submergence of the U. S. submarine *O-10* large quantities of water condensed in such a pipe.

Jones and Mankin (4), as a result of their tests on submarines made in the Tropics, say—

> The air under submerged conditions soon becomes saturated with moisture and the difference in the temperature between the outside water and the inside air is not sufficient to cause the heat to be carried off fast enough. Therefore,

in order to improve comfort conditions when submerged, it would seem advisable, if the military efficiency of the boat would not be hampered, to install a cooling and drying system in the forward and after battery compartments.

### *Neutralization of chlorine*

Fortunately, it is easy to neutralize chlorine, since it is very soluble in water and reacts quickly with alkalies. Water will dissolve from two to four times its volume of chlorine, depending on the temperature, and a chlorine mask may be improvised from a wet cloth held over the nose. The most highly efficient substance ever discovered for the neutralization of chlorine is the particular variety of soda-lime granules made by the Chemical Warfare Service, United States Army, for the removal of $CO_2$ in submarines. A handful of this placed in a handkerchief and held over the nose should give protection. Absolute protection against almost any concentration can be secured by wearing the Navy gas mask, which protects both the lungs and the eyes. Since chlorine does not affect the eyes, except in unusual concentrations, it is possible to use a simple soda-lime canister held in the mouth, the nose being stopped by rubber pads on a spring.

The submarine gas mask (submarine respirator Mark 1) protects against chlorine, carbon monoxide, hydrogen chloride, sulphur dioxide, gasoline vapors, oil vapors, carbon-tetrachloride vapors, and industrial smokes, such as those from burning insulation. This mask covers the whole face and protects the eyes.[6]

When chlorine is generated in the batteries it will remain low in the boat on account of the fact that it is two and one-half times as heavy as air unless it is stirred by ventilating fans. It can therefore be neutralized by spreading on the decks a layer of soda-lime from the carbon-dioxide outfit. In addition, the soda-lime blowers may be started. Metal parts can be protected from the corrosive action by smearing them with mineral oil.

### *Removal of arsine*

If it ever becomes necessary to remove arsine from the air of a submarine there are many reagents which will serve this purpose. The gas is readily oxidized by the Philips and Steele hydrogen eliminator. It is absorbed by a special gas-mask charcoal called "Whetlerite," which can be mixed with soda-lime in the carbon-dioxide outfit or used by itself in a canister or a blower. Soda-lime granules treated with permanganate are highly efficient also. Silver nitrate in solution has been used by the French. Naturally the most effective place to attempt the removal of arsine is in the battery exhaust. An obstruction to the flow of air through this duct may

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[6] For detailed description of this mask see arts. 2836–2841, Ch. XXVIII, C. & R. Manual 13).

not be objectionable when the boat is submerged and ventilating inboard, but any diminution of the flow of air may become extremely dangerous when ventilating outboard toward the end of the charge. If arsine poisoning ever should become a menace it would be possible to cure the trouble absolutely by removing from the batteries all materials contaminated with arsenic.

*Removal of carbon monoxide*

One of the important chemical discoveries of the Great War was made by Prof. J. C. W. Frazer, of Johns Hopkins University, working for the American University Experiment Station. He was given the problem of finding a material suitable for use in Navy gas masks which would remove carbon monoxide from the air. The substance adopted after much experimentation has been called "Hopcalite" and this is now placed in the submarine respirator Mark 1 canister. Wearing such a mask, it is possible to enter a compartment containing large amounts of carbon monoxide. It is also possible to use it in a large can on a blower and remove carbon monoxide from the air of a compartment. Fortunately, this gas seldom causes trouble in submarines.

## VI. Methods of Using Air-Purification Apparatus

The exact manner in which air-purification apparatus is used will depend largely on the conditions at the time of the submergence. No set of hard and fast rules can take the place of a knowledge of the principles which underlie the subject.

The simplest method consists in waiting until the members of the crew begin to pant on exertion, thus indicating the presence of about 3 per cent $CO_2$ in the air. The soda-lime apparatus is then started, and if it be in good condition an improvement in the air will become apparent at the end of a few hours. It is obviously impossible for a couple of blowers with a combined capacity of 50 to 100 cubic feet per minute to cause an immediate effect in a large submarine. Meanwhile the crew, being in an atmosphere which makes hard work extremely difficult, is unprepared for an emergency.

It will take two or three times as long for the oxygen to drop to a point where it gives trouble as it does for the $CO_2$ to rise to a level where it causes panting. Matches will no longer burn after the oxygen has diminished to about 17 per cent. There are no simple tests for lower figures, and in the presence of 3 per cent $CO_2$ there are no clear warnings of lack of oxygen until the men become unconscious.

The second method of determining when to use the air-purification apparatus consists in consulting the tables which show how long

each type of submarine can remain sealed before air purification is necessary.

TABLE 4.—*Length of time each type of submarine can remain sealed before air purification is necessary*

| Class of submarine | Net air space | Complement | Time in hours before air purification |
|---|---|---|---|
| | *Cubic feet* | | |
| N | 6,050 | 26 | 9 |
| O | 8,900 | 30 | 12 |
| R | 9,400 | 30 | 12 |
| S | 16,700 | 38 | 17 |
| T | 23,370 | 44 | 21 |
| V | 38,700 | 80 | 19 |

The instructions issued by the Bureau of Construction and Repair are given in Chapter XXVII of their manual (13).

The method of calculating how long it will take the $CO_2$ in the air in a submarine to reach a certain percentage is simple, but not very accurate. Knowing the number of men on board, the hourly production of carbon dioxide and consumption of oxygen can be roughly estimated from Tables 5 and 6. Under ordinary conditions the average of 0.75 cubic foot $CO_2$ and 0.9 cubic foot $O_2$ per man per hour may be used, but if a number of the crew are working hard higher figures must be employed. The estimated free air space in our submarines will be found in Table 4. The degree of contamination allowable may depend on circumstances, but at the present writing there seem to be few authorities who advise more than 2.5 per cent $CO_2$.

TABLE 5.—*Showing the variation in carbon-dioxide production and oxygen consumption of men at different degrees of activity* (3)

[Taken partly from actual experiments and partly from calculations]

| Man weighing 145 pounds | Heat production per hour | $CO_2$ produced per hour | $O_2$ consumed per hour |
|---|---|---|---|
| | *Calories* | *Cubic feet* | *Cubic feet* |
| Motionless in bed | 69 | 0.44 | 0.51 |
| Standing at ease | 76 | .49 | .54 |
| Walking at rate of 3 miles per hour | 230 | 1.48 | 1.65 |
| During "century run" on bicycle | 600 | 4.11 | 4.24 |

TABLE 6.—*Estimated figures for submarine crews*

| Man weighing 160 pounds | Heat production per hour | $CO_2$ produced per hour | $O_2$ consumed per hour |
|---|---|---|---|
| | *Calories* | *Cubic feet* | *Cubic feet* |
| Asleep in bed | 68 | 0.4 | 0.5 |
| Standing at controls, periscope, etc | 82 | .5 | .6 |
| Average during submergence | 123 | .75 | .9 |
| Working on engines, making repairs, etc | 250 | 1.6 | 1.8 |
| Hard work—rigging in hydroplanes, manning hand pumps, etc | 558 | 3.6 | 4.0 |

There are several theoretical objections to the method of calculating the time before which air purification becomes necessary. In the first place it is not always certain that the submergence has begun with pure air in all compartments. As a matter of fact, analyses in submarines on patrol frequently show considerable percentages of carbon dioxide in some compartments at the time of submergence. This necessarily upsets calculations. Another variable factor consists in the different degrees of activity of different crews. Ordinarily most hands are quiet, but in an emergency all may be working hard. The most important objection, however, to this method is the fact that it allows the air of the submarine to become vitiated to a point just short of being uncomfortable and then maintains the air at this bad level, running the air purifiers until the end of the submergence.

It would seem somewhat more rational to start the air purification and the replacement of oxygen early enough in the submergence to maintain the levels of both of these gases as close as possible to those found in atmospheric air. In order to economize materials the use of the soda-lime and the oxygen could be stopped three to six hours before the contemplated end of the submergence. This method would allow the $CO_2$ to rise to an objectionable level only for a short time at the very end instead of keeping it at this objectionable point for a long period. It requires no more soda-lime or oxygen to maintain the air at the good level than at the bad level. The only waste would occur if the submergence were ended unexpectedly at a time when the air in a submarine was still good.

A third method of controlling the air purification of submarines is to make analyses of the air and regulate the use of the apparatus accordingly. This is undoubtedly the most efficient method. It protects the personnel from the deleterious effects of exposure to bad air, it assures the commanding officer that the air is good enough to allow his men to work hard in the face of an emergency. It relieves officers and men of worry in regard to the condition of the air and has an excellent effect on the morale of the crew. Anyone who has made air analyses during a submergence will appreciate the fact that the air seems much better when a favorable report is given by the man who has just made an analysis. The psychic element is extremely important in all ventilation experiments.

Analyses of the air have another important bearing. They check up the efficiency of the soda-lime and serve to indicate when the can of material has become exhausted. It is to be hoped that the new soda-lime will be uniform in its activity, but all previous forms of apparatus and material have shown considerable variations and experience indicates that the soda-lime is not always doing its work.

Similarly, analyses make for economy in the use of soda-lime, enabling one to get the most out of each can.

Submarines at the present time are filled with all sorts of apparatus, which often proves of less value than the air it displaces, The submarine personnel has neither the time nor the inclination for unnecessary work. For this reason there will always be two opinions as to the advisability of placing air-analysis apparatus on submarines. Complicated machines would be advisable only if absolutely necessary. Fortunately the Higgins-Marriott device for the estimation of carbon dioxide is compact and permits any member of the crew with practically no training to make a determination in less than two minutes. As yet there is no apparatus of corresponding simplicity to estimate the oxygen, but, as we have shown above, it is permissible to allow the oxygen to make larger variations in percentage than the $CO_2$. The oxygen tanks are also positive in their action and easy to regulate.

A submergence controlled by air analyses might be conducted somewhat as follows: Every two hours after closing the hatches some officer or member of the crew would make a carbon-dioxide determination, using the Higgins-Marriott apparatus. When the carbon dioxide had risen to 1 per cent, probably at the end of about four hours, one of the soda-lime blowers would be put in operation. This would help to remove the odors in the air and diminish the rate of accumulation of $CO_2$. When the percentage of gas had risen to 1.5 a second blower would be started and continued in operation unless the readings again went below 1 per cent. At about the third hour after sealing hatches the contents of one 200-foot oxygen tank would be liberated and a new tank opened in about three hours, depending on the activity of the crew. The soda-lime cans would probably have to be changed every four or five hours, according to the results obtained by the analysis of the air. If it had taken, say four hours, at the beginning of the submergence for the carbon dioxide to increase 1 per cent, it would be fair to assume about this same rate of increase toward the end of the submergence and the blowers and the admission of oxygen could be stopped this length of time before it was intended to come to the surface. If it were found that the $CO_2$ were rising to 3 per cent, the blowers could be started again.

The estimation of hydrogen by means of the Burrell apparatus requires only three minutes and is accurate in the hands of anyone who has had a little experience. The use of this device will often surprise the commanding officer, since it not infrequently will show unexpected amounts of hydrogen in the air of the submarine. The palladized asbestos hydrogen eliminator is so simple in operation

that there is no reason why it should not be exposed to the air from the very beginning of the submergence. If checked up carefully by the Burrell apparatus, it serves as a rough hydrogen detector, since it becomes hotter and hotter as the percentage of hydrogen increases.

It is interesting to calculate from a theoretical standpoint the measures of service in an emergency which forces a boat to remain submerged for a long time. Naturally there should be an effort to limit the production of carbon dioxide and the consumption of oxygen by having as many of the crew as possible lie down and remain quiet.

It is essential that the commanding officer and a number of his staff be kept in an atmosphere containing less than 4 per cent $CO_2$ and more than 12 per cent oxygen in order that they may not suffer the mental confusion caused by badly contaminated air. Unless there is a small group of men who can think clearly and quickly, mistakes will be made and no one will be able to get the utmost benefit from the various measures that may be employed to save the lives of the crew. It is hard to conceive of any contigency that would require clearer thinking and better judgment.

It would be difficult but not impossible for one small group of men to secure relatively pure air. They could be stationed in one compartment with a higher allotment of soda-lime and oxygen or they could be stationed near the exhaust from the soda-lime can and near the outlet of the oxygen tank. If this were not feasible, special gas masks could be prepared by emptying the submarine respirator canisters of their usual contents and refilling them with fresh soda-lime granules packed tight and held in position by wire gauze screens. One such filling might last 10 to 40 minutes before shortness of breath warned that it was time for refilling. If the oxygen in the air were getting low, a man wearing such a mask should take a breath of pure oxygen from the tank every 2 or 3 minutes. In this manner it might be possible for a small group of men to retain their physical and mental efficiency unimpaired at a time when the other members of the crew were so helpless that they could not be of any service to a rescue party of divers. There is probably a period of several hours when the men are helpless but are not so far gone that they can not be revived by fresh air pumped into the ship.

There are various measures which will prolong the period of survival in such an emergency, but they can not be properly carried out unless there is some one on board who understands the principles of submarine ventilation and is in fit condition to apply them intelligently. Naturally, after an accident every effort would be made to bring the ship to the surface and to make the proper use of submarine escape apparatus. In the meantime, in order to limit the

production of carbon dioxide and the consumption of oxygen the men should be kept as quiet as possible and all who are not needed for work should lie down in their bunks. A man who remains motionless in bed produces about two-thirds as much $CO_2$ as a man wandering about the boat. After the air analyses have indicated that the $CO_2$ has risen above 2 per cent it would be advisable to start the soda-lime blowers, and use them in the ordinary manner until about two-thirds of the available supply of soda-lime has been exhausted. Two-thirds of the oxygen could also be liberated in the usual manner. When the $CO_2$ rises to 3 per cent some of the air might be pumped into a "dirty" bank and fresh air liberated to take its place. This process could be repeated until all the fresh air had been used. The air in the "dirty" banks should be saved, as it might be needed again when the $CO_2$ in the submarine had risen to 5 per cent. Next, the soda-lime which had been apparently exhausted by use on the Sturtevant blowers could be spread on the decks and crushed into a dust so that the interiors of the granules would be exposed to the air. This ground soda-lime should be stirred frequently and it is probable that its efficiency might be increased by sprinkling on it a little water, but not enough to make it lumpy. When these measures no longer suffice to prevent distress, recourse might be had to gas masks with canisters filled with the fresh soda-lime in the manner previously described. There is no experimental work on the efficiency of such masks, but on theoretical grounds it would seem possible with good soda-lime in the canister to survive in an atmosphere containing double the amount of $CO_2$ that would kill a man who was not so protected. We know from many experiments that an individual who takes an occasional breath of pure oxygen can live in an atmosphere which contains only half enough oxygen to support life in a man who does not thus augment the oxygen inhaled.

In some accidents on submarines chlorine is formed by the contact of salt water with the batteries. It is well to remember that soda lime exhausted as far as $CO_2$ is concerned will still remove chlorine.

The question is often asked, "How long can a given number of men survive in a submarine of given air capacity?" This is important in determining the time at which rescue operations should be changed into salvage operations. Such a calculation is difficult if not impossible. We can estimate that each man produces on the average 0.75 cubic feet of $CO_2$ per hour and consumes 0.9 cubic feet of oxygen. Knowing the number of the crew and the size of the compartment it would be possible to estimate the number of hours required to raise the $CO_2$ to 6 to 8 per cent, which is probably the fatal level, or cause a fall in oxygen to 6 to 8 per cent, which is

probably the fatal minimum for the gas. There are, however, many factors which must be taken into account. We can not always be sure how much soda lime, oxygen, and fresh air from the banks is available. We can not always be sure as to how many individuals have survived. It is quite probable that if 10 men were entrapped in one compartment 9 of them might die in three days and 1 sturdier individual survive for six days. The most important factor, however, in determining the period of survival would be the intelligence employed in utilizing the general principles of air purification.

[End of Part III]

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## PRIMITIVE SYPHILIS[1]

By C. S. Butler, Captain, Medical Corps, United States Navy

A little book which I have read many times is the translation into prose of Fracastoro's immortal poem entitled "Syphilis sive morbus Gallicus." Every time I read it I'm reminded of Don Quixote and his Squire, Sancho Panza. The Don, as you recall, was constantly walking "in the clouds" and his low-born Squire, by using some inescapable shaft of common sense, was as often engaged in reminding his master of those base degrees by which he, the master, had ascended. Many of these shafts never reached the Don at all. Some few convinced him that his Squire was right.

Research in medicine has been so much absorbed in new adventures, in discovering new principles, that it has oftentimes failed to listen to that Sancho Panza of our calling, the interesting and enlightening history of medicine. Nowhere is the value of the preliminary historical survey more clearly shown than in this very subject of syphilis. Had the truths set forth in the above-mentioned poem been taken to heart, much of the speculation as to the origin of syphilis could have been dispensed with, for he who wrote the poem was not only a contemporary of the discoverer of America, but was also one of the leading physicians and scientists of his time. He was a teacher at the University of Padua in 1502 and we may rest assured that he was well in advance of the medical learning and teaching of his day. He had seen the great fifteenth century epidemic of syphilis reach its apex and decline when in 1530 he wrote, after adverting to the view held even at that early date, that syphilis was a new world importation into Europe: "No; it is not in this manner that the disease has developed itself. Incontestable testimony proves that it is not of a strange or foreign origin and that it was not necessary to cross the ocean to arrive in our midst." To deny the author the full force of this statement is like denying to any modern authority the privilege of an opinion upon that subject about which he is best qualified to speak. But the very substance of the poem he gave to the world four centuries ago is sufficient to stultify the idea of an American origin for lues, because, to a physician, the poem bespeaks the medical lore of the 25 centuries preceding.

Another place where medical history would have stood us in good stead in this matter is in the question of yaws-syphilis differentiation. Dr. Thomas Sydenham, about 275 years ago, described yaws accurately in its symptoms and epidemiology and stated that it was just the lues operating in a nonvenereal rôle. Scores of epidemics of which we now have record among primitive peoples, both white and black, prove that Sydenham was right. But some medical Don Quixote,

[1] Read before the District Medical Society, Washington, D. C., Jan. 11, 1928.

craving adventure, found a "mare's nest" in this primitive expression of the old enemy and decided that yaws was a new disease, thus putting the master on the defensive, and getting away with the idea up to and including the year of our Lord 1927. But truth can wait upon that day when the Dons have worked off their superfluous energy and are ready to see reason.

That Fracastoro was conversant with medical thought of his own and of ancient times is shown by the fact that he knew that the virus of syphilis took some three or four months to manifest its symptoms. He thus describes the secondary incubation:

> One of the most surprising facts is that, after having contracted the germ of the contagion, the victim attacked by the scourge does not often present any lesion that is well marked before the moon has four times accomplished its travels. The disease, in fact, does not show itself at once by accusing symptoms directly that it has penetrated the organism. For a certain time it broods in silence, as if gathering its forces for a more terrible explosion.

Fracastoro knew and practiced the use of copper salts (Verdigris) as astringents for the throat ulcerations of syphilis, and he used mercury both by inunction and by fumigation. "As a fact," he says, "the action of mercury on the scourge is marvelous." Not only was he conversant with the medical views of his own day and of the ancients, but he was ambitious to find new remedies. "Under the ardent fires of Cancer," he says, "in the bosom of an immense sea in which the Chariot of Phebus plunges at the close of day, an island extends, narrow and long, which the Spanish navigators were first to land upon and in remembrance of their country they called Hispaniola. This land is sown with gold; but that which makes a greater wealth for it than gold is the precious tree to which the natives of the country have given the name Guaiac." At the time he wrote the little book in question, it is certain that guaiac had been in use in syphilis not longer than 606 has been in use with us to-day. The Spaniards first came across the guaiac tree (*Guaiacum officinale*) in Haiti early in the sixteenth century.

If Fracastoro's ideas of etiology were a bit "astrological" they were, nevertheless, about as good as those which obtained up to the middle of the nineteenth century, when research began to unshackle medicine from the thraldom of the past. His ideas of diagnosis, symptomatology, and treatment reflect one of the master minds in medicine.

Joseph Wood Krutch, in a remarkable paper entitled "The Paradox of Humanism," published in the December, 1927, number of the Atlantic Monthly, has shown that the mating habits of the human being though often described as "animal" are really not so at all, but are peculiar to the human animal. The lower animals, in general, restrict the mating season to the necessities of species reproduc-

tion, while the human being is the only animal "who loves all the year around." He might truly have said that civilized man is the only animal who loves all the year around and who is given to sexual debauchery, for he adds: "It is also, among anthropologists, notoriously 'a truism' that the more primitive races of men closely resemble animals in this respect."

Venereal diseases have for centuries been known to follow in the wake of civilization. Hirsch declares that syphilis appeared in America first in the sixteenth century in consequence of importation from Europe; its diffusion there (in America) has followed the track of immigration and colonization from east to west. He quotes Jullien to the effect that the development of syphilis in America affords a measure, other things being equal, of the progress of civilization in the several parts of that continent. To some regions, which had remained a long time remote from traffic, the disease has penetrated only in quite recent times, while still others continue exempt to the present day (1878).

African slavery may be said to have begun about 1442, when the Portuguese were exploring the west coast of Africa. When Nicholas de Ovando was sent out as Governor of Haiti in 1502 he found numbers of negroes already there. In 1510 King Ferdinand ordered a number of negro slaves to be sent there in order to work the mines. It was within 10 years following this date that importation of African slaves to the American Colonies began in earnest.

During the following three centuries many millions of slaves were imported into the New World, chiefly from the coastal African towns situated between Senegal on the west and Mozambique on the east coast. Europe therefore syphilized this coastal fringe of barbarous Africa and then sent this untreated syphilis over in the slave ships, as Sydenham states, under the name of "yaws."

We have it upon the authority of so good an observer as David Livingston, himself a physician ("The Travels of a Missionary in South Africa"), that the tribes in central Africa which had not had communication with the outside world were free from syphilis as late as 1854. We know that the same tribes of which Livingston spoke are to-day shot through with it, because when the barbarian takes on civilization's type of sexuality he acquires syphilis, and, as he doesn't treat it, the disease works havoc with him, for his stone-age personal habits enable the disease to uitilize largely the nonsexual type of transfer. This, in a nutshell, is the way the population of Haiti gots its present high incidence of syphilis. Three hundred years of the slave trade, 400 years of contact with Europe, and 400 years of no treatment for 99 per cent of its population are the causes.

In the early part of 1924 Admiral Stitt slated the writer for a tour of duty in Haiti, and I confess that I have never contemplated a

change of duty with more pleasure than this, because I saw in it an opportunity either to verify or disprove my own convictions that yaws and syphilis are identical, and that, too, in the modern stronghold of the so-called yaws. During the three years of my stay in Haiti I had the opportunity to visit practically every little village, hamlet, and community in the Republic. During all this time the Public Health Service of Haiti was supplied with a corps of medical assistants and hospital corps men from the United States Navy who, for thoroughness of work and for the character of support given the director of health, left nothing to be desired. There was never any clash over the diagnosis of the chief malady we were dealing with. We avoided any commitments as to views on etiology by using the term "treponematosis" to cover the yaws-syphilis group.

It is not possible in the time at my disposal to give all the reasons which confirmed me in the view that yaws is syphilis. In Haiti and upon the human being there are a number of separate considerations which point certainly to this conclusion. Here I am speaking only for myself, but I think I do not exaggerate the matter when I say that most of my assistants in the Public Health Service felt the same way about it.

Practitioners in civilized communities are not familiar with the worst types of untreated syphilis, such as formed the vast majority of the cases of the fifteenth century and subsequent epidemics of syphilis. The worst types of bone, joint, and infected skin lesions were noted. This is just what we see all over Haiti. I dare say very few in this audience have ever seen two or three hundred people applying at a clinic all infected with syphilis. That was, and is, a common experience in Haiti. These people, of all ages, show, some one type of lesion, some another, but mostly the worst tertiary skin and bone lesions. Now, to pick out from this mass of infected human material those showing the minor types which in Washington you would call syphilis, and then separate the severe, ulcerative, circinate, and papillomatous types and call them yaws, is the queer procedure which the "crack diagnostician" would have to submit to in Haiti. I always felt as if I were deceiving myself when I tried to do it. In cooperation with some of my coworkers in Haiti, three or four papers have been published dealing with the several features of this vexed question and I must refer my hearers to these papers for more extended answers to questions.

In closing my remarks upon primitive syphilis I wish to say that in May, 1927, we were favored with a visit to Port au Prince from Lieut. Col. Henry J. Nichols, United States Army. The death of Colonel Nichols, a short time later, has robbed our profession not only of a most kindly gentleman but also of one of its most ardent and successful seekers after truth.


Fig. 1.—Frontispiece of Frascatoro's poem, "Syphilis sive Morbus Gallicus"


Fig. 2.—Tailpiece of Frascatoro's poem

Colonel Nichols was shown a number of our clinics in operation and made inoculations into rabbits of material from both types. He seemed to be much impressed with the work of Jahnel and Lange using a Panama strain of *Treponema pertenue* in attempts to inoculate general paretics with yaws. In none of their experiments did they observe a positive result, but with the yaws virus they succeeded in inoculating a nonsyphilitic control man with the disease.

Colonel Nichols stated that he was almost prepared to accept the idea of unity of viruses, and, referring to the work of Ravaut and others upon the cerebrospinal fluid changes in primary and secondary syphilis, he outlined a series of parallel studies upon the cerebrospinal fluids of early yaws cases, and stated that if these showed the same findings for yaws as obtained for syphilis, he would be fully prepared to accept the unity opinion. These studies are now in process of being carried out under the direction of the present director of health of the Republic of Haiti, Commander Kent C. Melhorn, United States Navy.

In this connection it is well to remember, however, that severe secondary syphilis is rarely followed by tabes and general paralysis. This was noted long ago for Europeans by Fournier. Practically all writers upon primitive tropical syphilis have noted the rarity of these two recurrences in natives suffering from what is concededly syphilis. So that the secondary changes in the cerebrospinal fluid of native untreated syphilis may not be the same as those seen in Europeans. This is a question which it is hoped the research spoken of will disclose.

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## MEDICAL ASPECTS OF THE SALVAGE OF THE U. S. SUBMARINE "S–4"

By G. H. MANKIN, Lieutenant Commander, Medical Corps, United States Navy

By order of the Secretary of the Navy the last of the members of the *S–4*'s complement were declared officially dead on the 21st of December, 1927, and at that time the operations automatically changed from rescue to salvage. This declaration was based mainly, of course, on the valiant losing fight and death of Lieutenant Fitch and his five fellow occupants of the torpedo room. How long the other officers and men survived the collision will never be known. It is certain, however, that no signals came from any other part of the ship at the time the first diver, Thomas Eadie, C. G. M., walked on the deck of the *S–4*, 22 hours after she was struck.

On December 31, 1927, it was considered advisable that the engine-room hatch be opened in order that the divers might gain access to the control room to manipulate valves necessary for blowing ballast tanks and for such other operations as would be required in preparing the submarine for unwatering. Accordingly two divers descended

to the *S-4* and removed the nuts and bolts which held the engine-room hatch down. When the king bolt was knocked through into the engine room the water ran through the 1½-inch opening at such a rate that hammers, chisels, wrenches, and even the diver's hand were drawn toward the opening. This continued for three hours; how much longer is not known, because the *Falcon* was forced to unmoor on account of unfavorable weather and could not return for four days. During the three-hour period mentioned above no bubbles were noted to come out through the opening.

On January 4, 1928, the engine room hatch was opened and divers entered the engine room and found two bodies at the foot of the ladder in the space just forward of the engines. A third body was found in the forward part of the passageway between the engines. These bodies were passed up the hatch to a diver on the deck of the *S-4*, who secured each separately to body lines passed down from the *Falcon*. Before the divers were brought to the surface the bodies were hauled up to about 10 feet from the surface and held there until the divers were brought on the fantail of the *Falcon*. Then the body lines were passed to a working party in a motor launch. The launch moved away from the *Falcon's* side and the bodies were taken on board, placed in Stokes stretchers, tagged according to the order in which they were removed and the locality in which they were found, and covered with clean new canvas. The bodies were then taken to the sick bay of the U. S. S. *Bushnell* where they were washed up and placed in new canvas bags, put back in the stretchers, secured, then covered with a No. 6 ensign and placed under an armed guard on the quarterdeck to await transportation to the United States Naval Hospital, Chelsea, Mass., via the regular daily return trip of a destroyer from the United States navy yard, Boston.

On January 6, 1928, bodies Nos. 4, 5, 6, and 7 were removed from the passageway in the engine room. They were found lying down flat on the deck. Two were covered by a piece of canvas which proved to be a home-made windsail.

The divers found the water-tight door between the engine room and the central operating compartment tightly dogged and an attempt had apparently been made to improve the fit of the door against the flange. A piece of planking and a length of line were used for this purpose. Two screw drivers and a few other tools were found lying on the deck beneath the door.

On January 7, bodies Nos. 8, 9, 10, 11, 12, 13, 14, and 15 were removed from the engine-room passageway. Body No. 16 was found lying over the port-engine clutch. Divers having apparently removed all bodies from the engine room now continued back to the motor-

room door, which was found open. To appreciate the difficulties under which the divers had to make their search for bodies and, for that matter, do work of any description inside the submarine, one must remember that some of the divers were not thoroughly familiar with the interior construction of the *S-4*. To be sure, the majority of them had worked inside the *S-51*, and all of them had been taken through the *S-6*, sister ship of the *S-4*, but a considerable length of time had passed since the *S-51* had been raised; besides, the *S-51* and *S-4* differ greatly in their construction. Further, they were not in clumsy diving suits when inspecting the *S-6*, and the *S-6* was properly illuminated. In diving on the *S-4* the most powerful diving lamps obtainable were used, namely, 1,000 watts, but, even with these, the divers could see scarcely more than a foot away in the murky interior of the submarine. Wreckage increased their difficulties.

On entering the motor room the divers found body No. 17 lying on the deck. An oxygen flask was lying across it. The body was sent to the surface.

On January 11, bodies 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, and 32 were located and removed. All were lying on deck with the exception of No. 32, which was lying on a Gold Medal cot just forward of the hand-steering wheel on the port side. It is to be noted that an equal number, 16, were found in the engine room and motor room. Forty were known to have been on board the *S-4*, six were also known to be in the torpedo room, so there were two left unaccounted for. They were not found until the *S-4* was in dry dock in Boston.

At this point a word may be said in connection with the cursory inspection of the bodies at Provincetown. It was noted that all of the bodies were in excellent condition, particularly the first 15. Their complexion was ruddy and there was no bloating or discoloration of tissues. Several had one or both shoes off. One or two had removed their trousers. One officer and two enlisted men each had a raw, unpeeled Irish potato in the jumper pocket. One or more bites had been taken from the potatoes.

It is believed that the salt water, temperature 32° to 35° F., was responsible for the good condition of the bodies.

When the torpedo room of the *S-4* was opened in the dry dock at the United States navy yard, Boston, the air from that room was not particularly bad, and after portable Sturtevant blowers had been run for a short time to clear out the compartment, it was possible to enter without any difficulty. At the foot of the ladder one man was found lying on his back, one hand grasping the handrail of the ladder. Another was lying on his back with his head resting in the lap of the first man. Moving forward in the passageway the

next body found was also that of an enlisted man. The body was in a sitting position, leaning against the starboard reserve torpedoes. His legs were flexed and his feet were in the passageway. His trousers had been removed and were hanging on the ladder. In the space just forward of the reserve torpedoes three bodies were found, those of Lieutenant Fitch and two enlisted men. Lieutenant Fitch's body was lying on the deck beside a workbench on the starboard side, face up, feet forward, his head on his uniform cap. He was wearing regulation heavy submarine clothing and a 1923 Naval Academy class sweater. One galosh had been removed.

The next body was that of an enlisted man, lying head forward and to the port side, face up, and feet toward the body of Lieutenant Fitch. He wore submarine clothing and a kapok life jacket.

The sixth body was also that of an enlisted man and was found lying face up, head near the head of the port lower inboard reserve torpedo, feet pointing slightly forward and toward the body of Lieutenant Fitch.

These bodies were in good condition considering the length of time since death, three months. There was no marked bloating or observable disintegration in the parts covered by clothing. The hands showed marked shriveling of the skin, of course. The faces, particularly around the lips, showed some bloating, and the skin over the face showed varying degrees of brownish discoloration.

In order that the board of line and construction officers might be unhampered in their inspection of the interior of the *S-4* it was considered advisable that the bodies be prepared for removal and placed in spaces out of the way until such time as they could be removed from the submarine.

Accordingly, the medical party, under the direction of Lieut. Commander George B. Dowling, Medical Corps, United States Navy, wrapped the bodies in oiled sheets and placed them in Stokes stretchers, covered them with blankets, securely lashed them in, and placed them to one side out of the passageway and then began the search for the two bodies as yet unaccounted for.

One body was found lying over the starboard engine clutch with one arm around the clutch-releasing gear and the feet over the edge of the floor plates and pointing outboard and downward into the bilges. The fortieth and last body was found in a sitting position outboard of the port high pressure air compressor, on the port motor in the motor room. The latter was removed with considerable difficulty owing to the fact that his feet were locked behind a valve wheel, and, further, the opening through which the body had to be removed was very small.

These bodies had the same general appearance of those found in the torpedo room. They were handled in the same manner. After

night, when all visitors were excluded from the navy yard, all eight bodies covered by the national flag were removed from the submarine and placed in waiting ambulances of the United States naval hospital, Chelsea, Mass., where they were taken for official identification, examination, and final disposition.

###### CARE OF DIVERS OF THE U. S. SUBMARINE "S-4" SALVAGE FORCE

It may be of interest to state that no diver engaged in active diving on the wreck of the *S-4* was incapacitated for duty or prevented from taking his regular turn by reason of general illness or injury, with the exception of F. G. Michaels, C. T. M., United States Navy, whose lines became fouled in the wreckage of the *S-4* on the 18th of December, 1927, during almost impossible diving weather, causing him to remain on the submarine 3 hours and 20 minutes.

Even a slight cold is frequently sufficient to cause a diver difficulty in taking pressure, because of the congestion and swelling of the mucous membrane of the eustachian tube and the consequent trouble in equalizing the pressure on the two sides of the membrana tympani.

On being brought to the surface the divers' helmet, shoes, and weighted belt were removed on deck. The divers were then placed in the recompression chamber and the breast plate and diving dress removed there. The pressure was then run up to the amount prescribed in the decompression table. Following this the divers were decompressed in the usual manner.

Ideal conditions were present for the development of a host of respiratory and ear disabilities. In the salvage of the *S-4* the temperature of the water ranged from 32° to 37° F. The air supplied the divers was of the same temperature. Divers became thoroughly chilled and sometimes wet through a leaky exhaust valve, torn suit, or when an excessive amount of talking was required. When talking divers must stop the air flow so that hearing is not interfered with. Under these conditions the pressure in the suit diminishes and may not be sufficient to prevent a certain amount of water entering through the exhaust valve. On being placed under pressure in the recompression chamber the body of the diver is warmed up. As the pressure is released a marked cooling effect is noted and the diver requires additional clothing. On leaving the chamber the diver had to walk along an exposed deck and was thus subjected to low temperature and bad weather.

Each diver was given, when placed in the chamber, hot coffee and 30 c. c. of alcohol. Warm, dry clothing was provided for the divers who had got wet.

A careful check was kept at all times on the physical condition and morale of the divers. Each new diver was given a careful physical examination before being permitted to dive, even though

his health record showed a recent physical qualification for such duty. In addition, the regular divers were examined at intervals. Whenever a diver was noted to descend to the wreck in a slow and hesitating manner it was evident that he was having difficulty in equalizing the pressure on his ear drums and he was examined at the first opportunity to determine the cause of this difficulty.

Each diver was given a piece of chewing gum just before his helmet was screwed into position. This was done to increase the saliva flow so that swallowing was made easy. Divers were urged to clear their ears by swallowing rather than by pressing the nose against the bib and blowing. It was felt that the latter was conducive to plugging of the eustachian tube and secondary middle-ear affections.

The personnel, other than divers, suffered from perhaps an increased incidence of respiratory diseases of the milder type—coryza, bronchitis, and acute catarrhal fever. There were two cases of broncho-pneumonia.

When the diving operations were over and the *S-4* was in the dry dock, several cases of acute coryza occurred among the diving personnel, the first they had experienced during the rescue and salvage work.

One can not say definitely what factor or factors caused the diving personnel to escape respiratory diseases. Their general physical make-up was about the same as the other members of the crew. The items in which they differed from the others were:

(*a*) They were under compressed air in connection with their work and decompression.

(*b*) They received alcohol after each dive.

(*c*) They were more carefully watched for physical deterioration.

(*d*) They were given one week's leave out of every three weeks. The others were granted four days' leave in each calendar month.

In all other respects their lot was the same. They slept in similar quarters. The amount of crowding was the same and the food served them was from the same source.

### DIVERS' AIR SUPPLY

Weather off Woods End, Cape Cod, during the winter and spring months made diving particularly hazardous, not only on account of the high velocity winds and rough seas but also as a result of the ever present danger of moisture freezing in the divers' air lines. The latter occurred when the temperature of the outside air was well about 32° F. Such an occurrence may be well understood when it is known that compressed air was furnished to the diving line at approximately 150 pounds pressure and reduced at the diver's control

valve to a pressure a pound or two above that of the water where the diver was. In the case of a diver on the bottom alongside the *S-4*, the pressure necessary was 46 to 48 pounds. The relatively large expansion of the air and subsequent cooling effect present ideal conditions for the freezing of moisture in the air supplied the diver, particularly if the relative humidity of the air is high.

The first actual difficulty with air lines freezing was experienced around the 1st of January, 1928, when divers reported that the air flow was intermittent and that fine snow was blown into the helmet at times. An interruption of the air supply is serious at any time but is particularly so when divers are working inside a ship. On January 3, 1928, Thomas Eadie, C. G. M., United States Navy, reported that while he was in the control room of the *S-4* his air supply stopped for about two minutes, during which time he retraced his steps to the engine-room hatch through which he had entered the submarine. This meant passing through an extremely narrow passageway in complete darkness. Before he reached the hatch his air supply became normal and he completed his dive. Divers are aware of the fact that their suits contain a supply of air sufficient for about six minutes. Therefore, Eadie, a master diver, did not become alarmed or even inform those on the *Falcon*, but methodically made his way to a point where he could be hauled to the surface in case of need. When Eadie was brought up at the completion of his dive, his helmet was examined to find the location of the snow and ice deposits. It was found that the most notable amount collected in the nonreturn valve which is located in the line beyond the diver's control valve and near the helmet.

Following this occurrence it was decided to place a helmet over the side and lower it to the 100-foot level and supply it with the normal flow of air each day before active diving operations were begun. In addition, an empty diving dress with helmet, breastplate, weighted belt, and diving shoes were placed over the side at the regular diving depth and the return of bubbles from both the helmet and the inanimate diver, "Jake," were observed for a period of time before divers were put down to the wreck. While it was realized that the relative humidity of the outside air was not a measure of the relative humidity of the diving air, it was felt that such a determination, together with the use of the submerged helmet and the dummy diver, would provide an indication as to the probable safety of diving operations.

At this time a proposed remedy for the difficulty was recommended to the commander, U. S. Submarine *S-4* salvage force. The type of air system suggested was as follows: (*a*) A separator to remove the moisture incident to compression, (*b*) a volume tank or receiver

with a large cooling coil to reduce the temperature and thus cause moisture to drop from suspension, and (*c*) a heating unit to raise the temperature and, incidentally, lower the relative humidity. Further, the heating would prevent freezing in the diving manifold passing around the deck house and in the diving hose and helmet connections. (*d*) The diving manifold to be either lagged or placed inside the deck house.

Meanwhile more and more difficulty was experienced with freezing of the air lines. The pressure in the diving manifold was reduced from 150 pounds to 100 pounds without appreciable benefit. The 100 pounds pressure was within the prescribed limits in the Bureau of Construction and Repair Manual which requires that an air pressure from 30 to 50 pounds over and above the sea pressure be maintained on the diving air line.

On January 17, 1928, the air temperature was 38.5° F., the water temperature on the bottom was 38° F., and the relative humidity was 64 per cent; still freezing occurred and prevented diving.

On the following day, with the air temperature 40° F., water (bottom) 37° F., and relative humidity 56 per cent, freezing occurred.

On the succeeding day, with the air temperature 34° F., water (bottom) 37° F., and relative humidity 87 per cent, no diving was possible on account of air lines freezing.

Thus diving was prevented either by rough weather or freezing of air lines until the *Falcon* went to the navy yard, Boston, Mass., for alterations, which followed the general scheme outlined above. The air, after compression, was reduced in temperature to that of the circulating water in the cooler, 32° to 35°, and a considerable amount of water was thrown out of suspension and drained off. The air was then heated to approximately 190° F. and passed to the diving manifold which had been lagged. The temperature in the diving manifold ranged from 160° to 120° F., depending upon the distance from the heater. From the manifold the air was taken off by the divers' lines. The air, after passing through 600 feet of diving hose, 100 feet or more of which was in the water, was reduced in temperature to approximately that of the water, and little difficulty was experienced from fogging. Too much praise can not be given to the technical skill and professional knowledge of Lieut. W. J. Murphy (CC), United States Navy, who did the actual designing and installing of the present air-supply system on the *Falcon*. It had seemed that diving operations could no longer be carried out with safety to personnel and that work would have to be suspended until spring, as has been done in the case of the salvage of the U. S. submarine *S-51*, but the alterations discussed above overcame the matter of freezing, and divers stated they had never had such excellent air

supplied to them. Diving was continued without interruption, except by rough weather, even though at times the air temperature (outside) was 14° F. and the water temperature on the bottom was as low as 32° F.

A calcium chloride container, through which the air could have been passed if it was found that the freezing was not entirely overcome, was included in the system placed on board the *Falcon*. Fortunately, its use was never required.

### COMPRESSED AIR ILLNESS AMONG THE DIVERS

There were 10 cases of compressed-air illness as a result of the 566 dives made in connection with the salvage of the U. S. Submarine *S-4*, an incidence of 1.76 per cent. All of these cases were mild, although some were troublesome in that in two or three instances the patient had to be recompressed in the chamber twice and, in one case, three times.

It was noted that certain men are more susceptible to compressed-air illness. Others seem to be almost immune. It was further noted that whenever divers were required to do strenuous work on the bottom or to prolong the dive beyond the prescribed length of time, one hour, cases of this disease were to be expected.

It was noted, in general, that that part of the body which showed the greatest muscular activity was most affected—for example, the forearm, where hammering was required, and the knees, where much stooping was called for.

There were six cases in which the arm or forearm or both were affected. In one of these cases the leg also was the seat of pain. There was another case in which the back muscles were involved. This diver had been doing considerable bending and lifting.

There were three cases in which an erythematous maculopapular rash was present over the abdomen and back, accompanied by itching and burning of the affected area. In addition, the pupils presented an irregular contour. The irregularity of the pupil disappeared and the rash began to fade out as soon as the patient was put back into the recompression chamber and the pressure run up.

Symptoms in nearly all cases were relieved at from 15 to 25 pounds (gauge) pressure; but, for purposes of treatment, the pressure was run on up to from 50 to 100 pounds, depending upon the severity of symptoms. A typical decompression table used in treatment is given below.

The patient is returned to the chamber an hour or two after a dive and the regular chamber decompression, complaining of pain in the right forearm. The pressure is run up to 50 pounds, although the pain is relieved at 15 pounds. The patient breathes a 40 per cent

helium mixture for 15 minutes while at 50 pounds. Then the pressure is dropped to 25 pounds through 25 minutes and is held at the various pressures as follows: 25 pounds, 10 minutes; 23 pounds, 10 minutes; 20 pounds, 20 minutes; 18 pounds, 20 minutes; 15 pounds, 20 minutes; 12 pounds, 20 minutes; 9 pounds, 30 minutes; 6 pounds, 30 minutes; 4 pounds, 30 minutes, then out of the chamber. In case the diver has a return of symptoms he is again returned to the chamber, but this time a higher pressure is used, 80 to 100 pounds, and then the decompression is carried out in appropriate stages.

In this connection it appears that it would be desirable to have two decompression chambers on such rescue and salvage ships as are built in the future or converted for this purpose. There are times when the facilities of a single chamber are sorely taxed—for instance, when, during the regular decompression of divers brought from the bottom, it becomes necessary to return others to the chamber for a long-drawn-out recompression in the treatment of compressed-air illness.

Through training divers have become expert in their art, their courage is unquestioned, diving equipment has been constantly improved, ships and their salvage material have been rapidly increased in efficiency and usefulness, but as yet no feasible method of controlling the elements has been evolved, and this may be found the most potent reason for the Navy's failure in its magnificent attempt to rescue the six shipmates in the torpedo room of the *S-4*.

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## EVERYDAY PROBLEMS IN OBSTETRICS

By David S. Hillis, Captain, Medical Corps, United States Naval Reserve

A very large proportion of pregnancies and labors may and do proceed to a successful termination without the need of more assistance than can be rendered by a midwife. It is, however, impossible to select these cases in advance, and the mortality and morbidity in the smaller number of pathological cases makes it imperative that every confinement be regarded as a potential tragedy. There is a certain incidence of unavoidable injuries or fatalities to mother and child, but the largest number of bad results in obstetrics are due to errors in art, principally errors in diagnosis and management.

Correct diagnosis in obstetrics is as fundamental a requirement as in any other branch of medicine. Management of the labor case is the next most important prerequisite to good results, and this fact is seldom emphasized. Obstetric strategy is as important to the doctor in charge of a confinement case as is military strategy to an officer in charge of troops in the field: Human life is at stake in each instance. A correct maneuver made at the wrong time or a wrong maneuver at any time may bring disaster. In the labor room

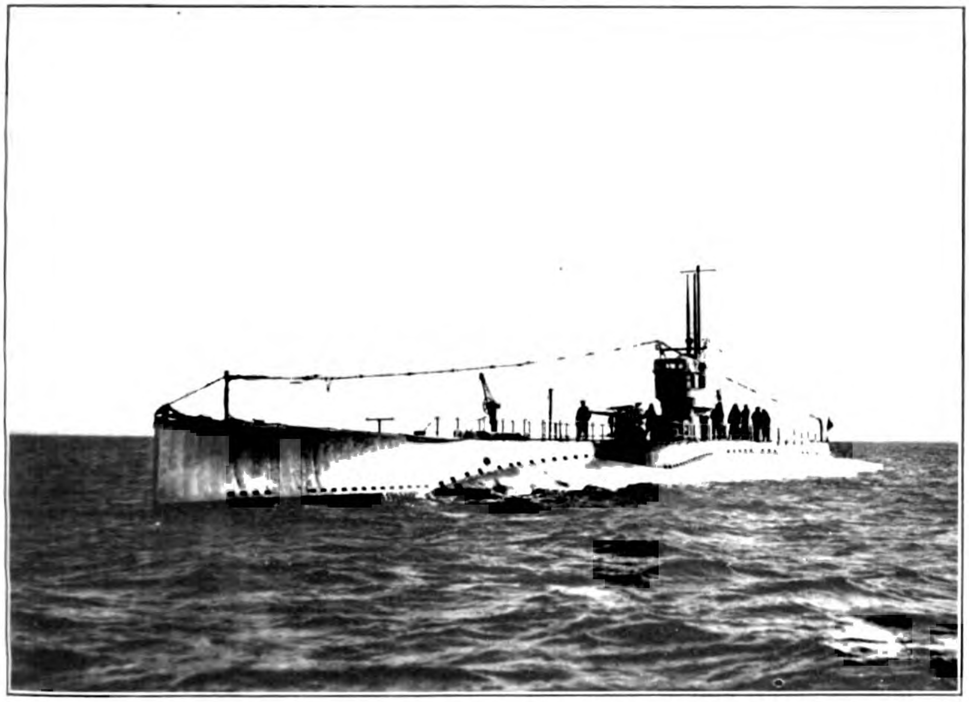

Fig. 1.—The S-8, sister ship of the ill-fated S-4. (International Newsreel photograph)

Fig. 2.—Diver being brought on board the Falcon. Note arrangement of life line and air hose at diver's back, the weighted belt, the lacing in of the suit about the legs. The descending line by which divers lower themselves to the wreck is seen hanging down from the forward bitt. (International Newsreel photograph)

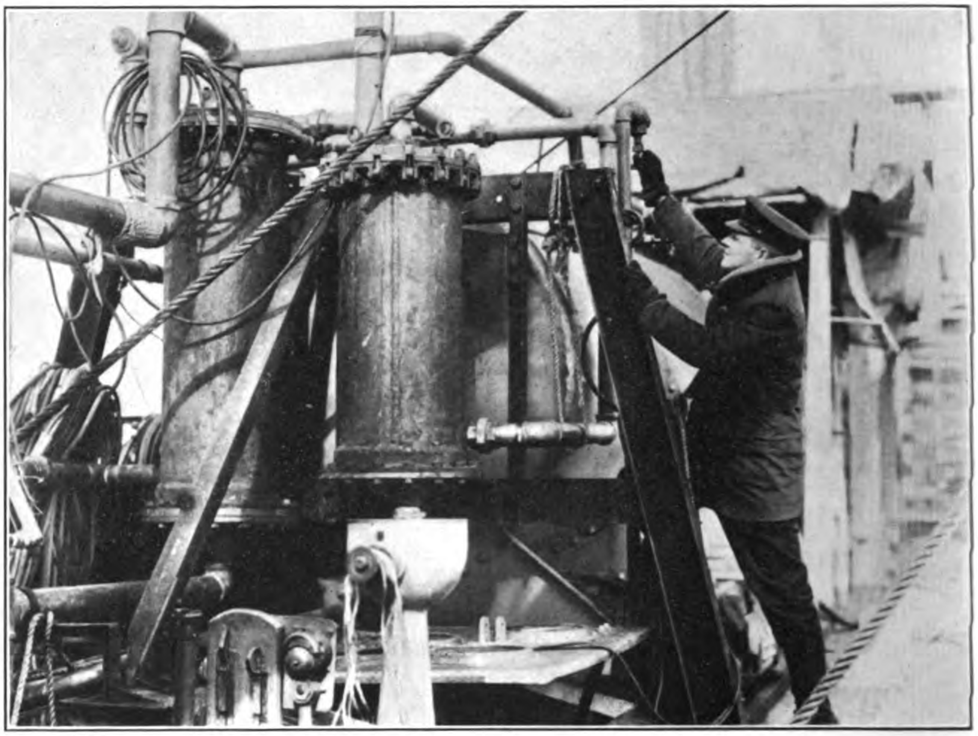

Fig 3.—A portion of the divers' new air supply system on the Falcon. The large tank behind is the receiver for air coming from the compressors. It has a small cooling coil in the interior. An auxiliary cooling unit is seen at the left. On the right is the calcium chloride container (International Newsreel photograph)

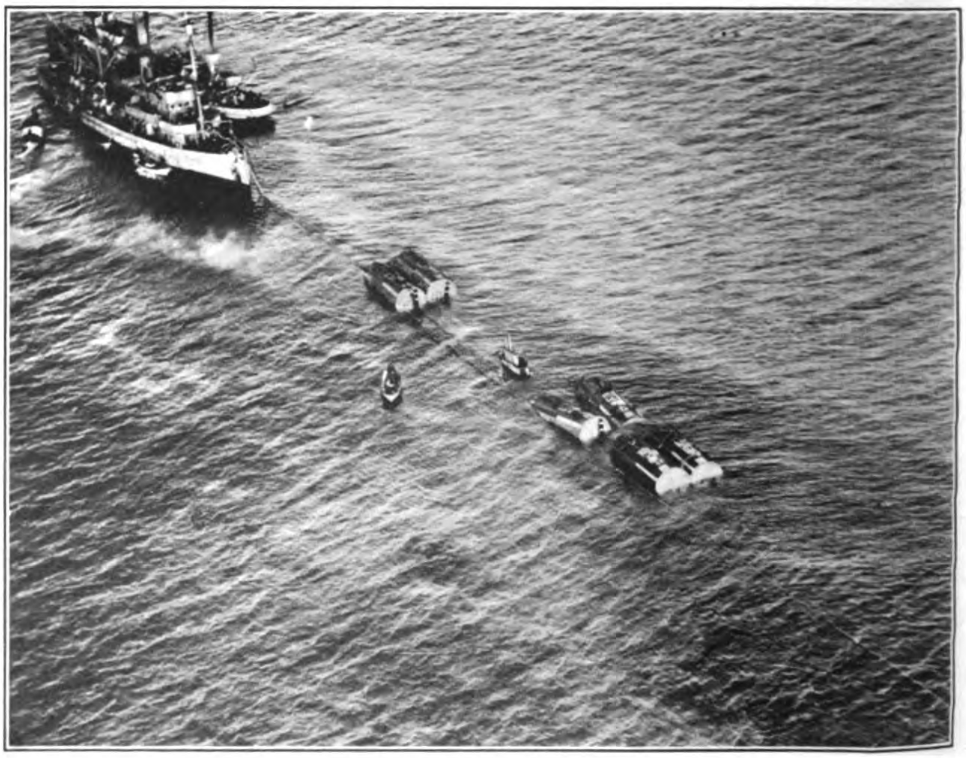

Fig. 4.—The S-4 just before being towed from Provincetown to Boston. The Falcon was towed behind the submarine and supplied the pontoons and compartments with air by means of lines leading over the bow. (International Newsreel photograph)

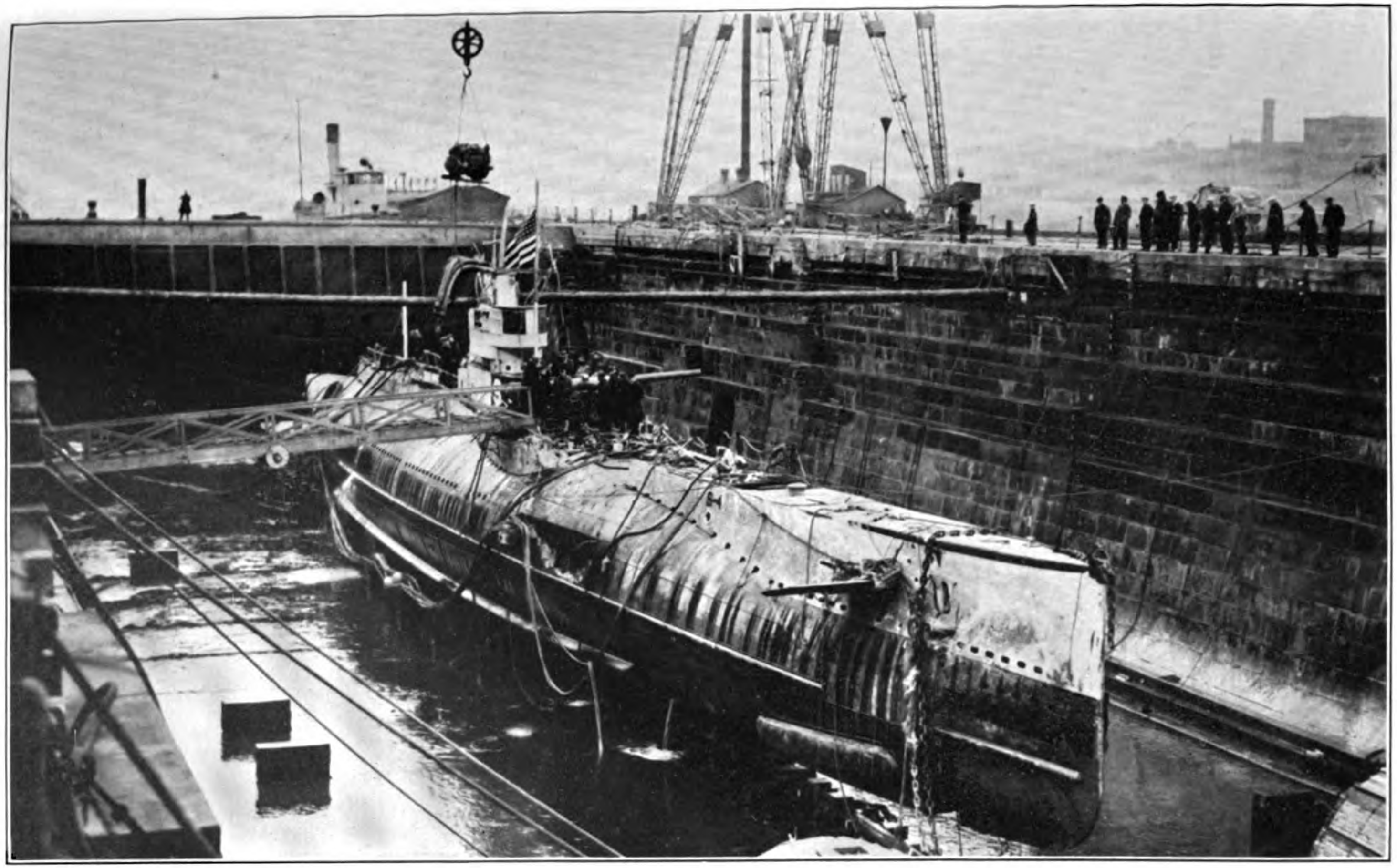

Fig. 5.—The S-4 in drydock at the navy yard, Boston, Mass. Note the hole in the starboard side, made by the Paulding. The bow planes are at "hard rise." The gun muzzle was moved to the port side by the impact of collision. (International Newsreel photograph)

or on the field of battle the proper strategy indicates to us what to do, when to do it, and how to do it. The doctor who does an operation at the wrong time or does one operation when another procedure should be used may be compared to the military commander who makes an attack prematurely or sends his men against an impregnable nest of machine guns.

It requires only a moderate amount of experience to do a low forceps operation with everything favorable or a version and extraction when all conditions are fulfilled; either of these operations may result in death or injury to mother or baby in the hands of anyone if not done under the most favorable conditions. Intelligent management of labor may either avoid operative procedure entirely or secure conditions which make a necessary operation comparatively safe and easy. The consultant frequently sees cases that have been poorly managed; obstetric strategy has been faulty. In many such cases the serious outcome could have been avoided if the case had been properly managed from the start. When proper management is not used the baby may die, because an extraction has been attempted as soon as a foot could be reached in a breech delivery, or because the heart tones had not been observed in the second stage in a normal case, or because a contracted pelvis had not been diagnosed before labor. Or a mother will die from hemorrhage or ruptured uterus because a forceps was applied through an undilated cervix, or because the urine and blood pressure were not watched during pregnancy, or even perhaps because the uterus was curetted for fever in the puerperium.

Posterior occiput position stands out prominently in the list of conditions in the labor room which contribute to the mortality and morbidity of the mother and child. This condition occurs in from 20 to 30 per cent of vertex presentations and though it is a fact that about 80 per cent rotate to the front and deliver spontaneously, the remaining 20 per cent present some of the really difficult problems in obstetrics, and it is among these cases that the value of the proper management of a labor case may be so well demonstrated. It is just as important to know when not to interfere in labor as to know what to do after it is found that something should be done, and more errors are committed by untimely interference than by making a wrong choice of operation. An hour's difference in time alone may determine whether the outcome will be a tragedy or a safe, easy delivery.

Labor averages from 50 to 100 per cent longer in posterior occiput than in the cases where the small fontanel is anterior to the transverse diameter of the pelvis. The bag of waters often ruptures prematurely and the cervix dilates very slowly. Though the pains

may be of normal strength and frequency the cervix is not affected in proportion and after hours of labor the mother or baby may show signs of exhaustion with the cervix only partly dilated and the head still above the ischial spines and not rotated. An extraction with forceps under such conditions is always a formidable operation and shows a high fetal mortality with a serious maternal morbidity and death rate.

To avoid these results the management of the case begins with an early and accurate diagnosis. The patient is told to lie on the side toward which the occiput points. She is not allowed to continue with her pains until she has reached a point near exhaustion. After five or six hours of labor with no corresponding effect on the cervix the patient is given one-sixth of a grain of morphine with one two-hundredths of a grain of scopolamin and allowed to sleep or rest for several hours. After the effects of the narcotic have worn off the pains may return with greater force and it often will be found that the cervix has continued to dilate under the influence of the drugs. This device may be repeated once or twice during a long labor with benefit. The morphine seems to have a relaxing effect on the cervix, and it is believed to aid in the dilatation, contrary to what might be expected. The morphine should not be given within three or four hours before delivery on account of the danger of morphine poisoning in the baby. Every effort should be directed toward conserving the patient's strength until the cervix is fully dilated, after which a spontaneous delivery may occur or the head may be low enough to permit a safe delivery with forceps. As long as the bag of waters remains intact the baby is comparatively safe. If rectal examination is made or the intervals are limited, the patient can be carried along with intervals of rest until the delivery can be safely accomplished.

Even after complete dilatation has been secured, the head may be arrested in rotation and descent on account of the faulty attitude or inefficient pains and here there is need of more patience and, provided the condition of the mother and child permit, it is best to wait longer in order to secure as much rotation as possible before operating if a spontaneous delivery does not occur. When signs of exhaustion appear, as indicated by a sharp elevation of pulse or rise in temperature in the mother or abnormal variations in the fetal heart tones, the forceps are indicated. This operation is comparatively simple and harmless if properly done with the cervix dilated and the head below the ischial spines. With those conditions not present it is a difficult and dangerous procedure for both mother and babe even in the hands of the most experienced operator. When the small fontanel is posterior to the transverse diameter or in that diameter,

the head is rotated by hand until the occiput is anterior or nearly so and the blades applied to the sides of the head. Upon the success of this rotation depends, to a great extent, the amount of injury that will be done to the mother or baby, and without it the forceps extraction may be impossible. An accurate diagnosis by means of the fontanel or ear is, of course, necessary.

The head is grasped with one hand in the vagina, the other hand making suitable pressure above the symphysis on the brow. In most cases some rotation is accomplished with ease but when the hand is removed the head returns to its former position before the blades can be laid on. This may be prevented by grasping the scalp of the baby near the small fontanel with a heavy mouse tooth volsellum forceps and while an assistant holds the head in position with the volsellum the blades are applied. After locking the forceps, examination will often show that the head has rotated still more in the grasp of the instrument and that the blades lie properly on the sides of the head with the small fontanel anterior. The extraction now is as in occiput anterior and with a low head offers little or no difficulty.

## ECLAMPSIA

The cause of eclampsia is as yet unknown and the results of treatment are still far from satisfactory. There is some difference of opinion about the relative merits of so-called conservative treatment which attempts to control the disease by medicine, and the radical treatment which has for its purpose the prompt termination of the pregnancy by one or another operative procedure. The tendency at present is more in the direction of the method of Stroganoff, who does not induce labor but treats the eclampsia as a medical condition. He claims results that are not equaled by any other method so far proposed.

However uncertain the outcome when the convulsions have begun, one fact, I believe, has not been sufficiently emphasized, namely, that eclampsia is a preventable disease. The obstetric specialist rarely sees an eclampsia among his own patients, for a large part of his prenatal work is directed toward its prevention, and he frequently finds it necessary to induce labor to circumvent its occurrence. The eclampsia occurs among the ignorant cases who have had no prenatal care and among the patients of the doctor who has not educated them to report to him early and often during pregnancy, or who possibly has underestimated the importance of the signs which always precede eclampsia.

Since the mortality of eclampsia after the convulsions have begun is in the neighborhood of 20 per cent, and the mortality of the pre-

eclamptic state is 0, the best results are obtained in recognizing the approach of eclampsia and preventing the onset of convulsions. Almost without exception it will be found that one or more of the classical symptoms of threatened eclampsia are present in time for preventive measures to be instituted. As these symptoms most often occur after the period of viability of the child, labor may be induced and pregnancy terminated without sacrifice of the life of the baby.

It must be remembered that any one of the well-known signs or symptoms may be the only indication of the oncoming attack and that any one, even an elevated blood pressure, may be absent shortly before the outbreak. Perhaps the most reliable single sign is a rapidly rising blood pressure; the next most common symptom is headache: eye symptoms, varying from slight dizziness to total blindness, are of importance in direct proportion to their severity; epigastric pain is less frequent, but, when present, is a sign of the utmost importance; edema above the knees is a frequent part of the picture; nausea is less common and may be due to other causes; urinary findings are important but the absence of albumin in the urine, in the presence of one or more of the other symptoms, does not mean that the patient is safe from eclampsia and in a fairly large percentage of cases albumin is not present until after the first convulsion.

Management of this condition is comparatively simple and consists of rest in bed, nonnitrogenous, salt-free diet, elimination, close observation of symptoms, especially blood pressure, morphin and sedatives as needed, and induction of labor if improvement is not definite and satisfactory.

## PLACENTA PREVIA

No woman should bleed to death in placenta previa. Placenta previa carries a maternal mortality of about 80 per cent in untreated cases and from 8 to 20 per cent in treated cases in general practice. The death rate in the mothers should not be above 3 per cent. The fetal mortality rate is from 4 to 60 per cent and permits no reduction except at the expense of a higher mortality in the mother with any treatment except cesarean section. Certainly a large part of the high maternal death rate in this condition is due to improper management and ill-advised treatment. The indications are to stop the hemorrhage and let the patient deliver spontaneously and the most common error is in hastening the delivery, which increases enormously the danger to the mother in behalf of an often premature infant with a very small chance for life at best. There is no discredit attached to losing the baby in placenta previa delivered from below. No woman should die of hemorrhage in placenta previa after the diagnosis is made. A cardinal principle in the manage-

ment is to terminate the case as soon as the diagnosis is established. A causeless, painless hemorrhage in the last three months of pregnancy is almost diagnostic of placenta previa.

There are four operations to select from: First, rupture of the bag of waters, leaving case to deliver spontaneously; second, Braxton-Hicks version, bringing down a leg and leaving case to deliver spontaneously; third, colpeurynter, followed by version after bag is expelled, if necessary, or leaving case to deliver spontaneously; fourth, cesarean section.

There are two things that should never under any circumstances be done: First, any kind of rapid dilatation of the cervix, manual dilatation, instrumental dilatation, or cutting operation; second, extraction of the baby either with forceps or by traction on a foot. Even when the extraction by the breech is easily accomplished with the cervix dilated, tear may result with fatal hemorrhage. Packing the vagina in placenta previa should be done as an emergency measure only. I have not packed a case of placenta previa for 15 years because nothing can be gained by packing. Time is lost, blood is lost, and the dangers of infection increased.

## CHOICE OF OPERATION

Cesarean section is done only in cases where the baby is alive and near term and no vaginal examinations or manipulations have been made. In competent hands and with properly selected cases the maternal mortality should be less than 4 per cent, and the fetal about 2 per cent. The objection to the operation is that it leaves a scar in the uterus, and it may occasionally be done in cases where a simple rupture of the bag of waters would have been sufficient.

*Rupture of the bag of waters.*—In cases where the placenta is not low enough to even partly cover the os that admits one or two fingers, a rupture of the bag of waters may permit the head to descend enough to press on the placenta and stop the hemorrhage, bring on labor, and result in a normal spontaneous delivery. When this method is tried, preparations should be made to do a Braxton-Hicks version or place a bag if the bleeding does not stop promptly after the bag is ruptured.

*The Voorhee's bag.*—This method carries a higher mortality for the mother and is somewhat less dangerous for the baby than Braxton-Hicks version. It is not used in cases where the patient has already suffered a severe loss of blood and may be used in cases where Braxton-Hicks version or cesarean section can not be done. The bag placed above the placenta stops the hemorrhage, stimulates the pains, and if it is large enough is followed immediately by the

head which prevents further hemorrhage until the delivery is complete.

*The Braxton-Hicks version.*—This is the operation par excellence in placenta previa for the general practitioner and in emergency from the standpoint of the mother. Complete relaxation under anesthesia is of prime importance, the head usually being high and the fetus movable. Two fingers are gently passed through the cervix and the bag of waters ruptured or the placenta bored through if it completely covers the os. The head is pushed up and the hand on the abdomen brings down the breech, a foot is secured and brought through the cervix. Now the patient is safe provided she is allowed to wake up and deliver herself, but the reaction of every operator to this situation fills him with the desire to terminate the case at once, and obedience to that impulse is what kills the mother. The experienced operator seats himself at the foot of the table or the side of the bed and patiently waits until the pains expel the baby. Before the patient wakes from the anesthesia it may be necessary to make about a one-half pound traction on the leg to control the bleeding. After the pains are well started the bleeding will be controlled by the advancing fetal body and traction will not be needed. Care is taken not to tear the cervix, in extracting the after-coming head, and there is no need for hurry. If bleeding occurs after delivery the patient is given one or two ampules of pituitrin and, if necessary, the placenta removed manually and the uterus packed with 6 to 12 yards of gauze, one-half yard wide. If the cervix has not been torn, the postpartum bleeding may not occur at all or will promptly be controlled by pituitrin.

## AVIATION GOGGLES: THEIR EFFECT ON VISION

By J. R. Poppen, Lieutenant Commander, Medical Corps, United States Navy

The excessive wind incident to flying requires that the eyes be shielded by protective devices. The tendency in commercial craft is toward inclosed cabins in which the pilot as well as the passengers are inclosed in compartments with windows and wind shields. In certain types of military craft, particularly in transport planes, the same thing is true. But in the great majority of planes used for military purposes, range of visibility, ease of control, and maneuverability require that the protection take the form of small wind shields and goggles. The former are most commonly transparent baffles which divert wind blasts from the pilot's head and face with a minimum of head resistance and destruction of stream line. Performance of the plane is reduced by provision for comfort of the pilot.

Wind shields are absolutely necessary in high-speed combat and pursuit planes, because if the head were directly exposed to the more than 200 miles per hour air speed of the slip stream it is questionable if the muscles of the neck could support it. Movement of the head would certainly be restricted sufficiently to interfere seriously with the execution of the mission.

Goggles, on the other hand, afford considerable protection if properly made and introduce no additional reduction in the performance of the plane. They do not restrict the field of vision nor distort the image. The development of goggles has progressed with the development of aviation to such an extent that the specifications for new goggles are restrictive and exacting to a degree—and properly so. Goggles recently adopted by our Bureau of Aeronautics, described and illustrated by Davis (1), are the product of months of experiment and considerable expense. They embody the very best principles and promise to be the most satisfactory yet devised.

The problems confronting those charged with construction of goggles range from composite physiognomy, through metallurgy, heat conduction, ventilation by exhaust, and direction of stream, to refractive index of transparent media and the vicissitudes of lens grinding.

Briefly, the requirements for goggles are: (1) No limitation of the field of vision, (2) no distortion of vision, (3) a proper fitting to prevent leaks, (4) comfort, (5) elimination of materials apt to cause injury in case of crash (2). It is not the purpose of this short paper to discuss in detail these requirements.

Distortion of vision by goggles includes not only reduction of visual acuity but loss of ocular poise, depth perception, or muscular strength as well. There are two possibilities. Goggles may distort vision immediately they are put on or they may produce defect after continued wearing.

It has been demonstrated that poorly fitting goggles which are not carefully decentered will disturb poise even to the extent of two or more diopters of hyperphoria after continuous wearing for six or eight hours, and that this disturbance lasts for a considerable period of time. In an effort to determine to what extent vision was distorted immediately after putting on service types of goggles, one hundred aviators were examined, first without goggles and then with their goggles.

The pilots were instructed to bring with them when they reported for their annual physical examination the goggles which they habitually wore. In a few cases pilots brought more than one pair, in which case each pair of goggles has been included as a separate examination in this series.

Each pilot was examined with and without goggles. The examinations made were for (1) visual acuity, (2) depth perception, (3) Maddox rod screen test at 6 meters, (4) Maddox rod screen test at 33 centimeters, and (5) prism divergence. The following analysis is taken from the findings in the 100 aviators thus examined:

The goggles examined divided themselves into three types. The first type, known in this analysis as type A, are known as the "passenger type." The lenses are plain, flat, colorless glass mounted on rims backed by fur or chenille. This type is the one most commonly used for average flying and is issued to students for preliminary instruction. They do not conform to the best principles, in that there is no attempt to decenter the lenses, and are of rather rigid outline, preventing adjustment to individual variations of physiognomy. However, they are found to be very satisfactory for ordinary service flying and are preferred by many to goggles which are better in principle.

Type B of this series is known as the "pilot type." They are the type usually known as the "gogglette" and consist of plain glass lenses curved to conform to the lateral curve of the face, so that they are decentered for the lateral fields of vision. They are mounted on rigid frames joined by a nose piece adjustable for interpupillary distance. The rims are very rigid and are backed by rubber cushions, either pneumatic or sponge. They are equipped for ventilation. Two types of lenses were found in type B. One, known as type B–1, is plain cylindrical in which the vertical plane is straight, the horizontal plane curved to conform to the arc of ocular rotation. The goggles of type B–2 are equipped with the meniscus type of lens, in which the vertical as well as the horizontal plane is curved to conform to the arc of ocular rotation. These lenses are carefully decentered to avoid spherical aberration at all angles of the visual axes. The analysis brought out that there was some variation in the amount of distortion produced by the different types, as will be indicated under the separate headings.

Instructions to the examinees were couched to preclude any inference that the goggles either distorted or improved vision. The general attitude toward the examination indicated a conviction that goggles were a considerable handicap, as was particularly apparent in the case of those who brought more than one pair "to see which was the worse." Because of this attitude there was a definite increase in effort and attention in the tests with goggles.

The routine of that part of the examination included in this analysis was as follows: Depth perception without goggles; with goggles; visual acuity, Maddox rod screen test at 6 meters and 33 centimeters, prism divergence, and visual acuity without goggles; Maddox rod screen test at 6 meters and 33 centimeters, prism divergence, and

visual acuity with goggles. All examinations were made by the same observer.

Without including the detailed recapitulation of the findings they will first be analyzed according to the separate functions examined and then generalizations enumerated in a concluding discussion.

### VISUAL ACUITY

The analysis shows very little effect upon vision. Of the 200 eyes examined, 42, or 21 per cent, showed slight improvement in vision. The least improvement was from 20/15 minus 1 to 20/15, and the greatest from 20/15 to 20/10. Thirty, or 15 per cent, showed reduction in visual acuity. The least impairment was from 20/15 to 20/15 minus 1; the greatest from 20/15 to 20/20. The outstanding finding is that in no case did the goggles produce disqualifying degrees of visual acuity in eyes which had acceptable acuity without goggles.

There was very little difference in the effect of the different types of goggles as indicated by the following table:

TABLE I.—*Effect of goggles on visual acuity*

| | Vision improved | | Vision decreased | | Vision unaffected | | Total |
|---|---|---|---|---|---|---|---|
| | | *Per cent* | | *Per cent* | | *Per cent* | |
| Type A | 30 | 25.5 | 18 | 15.2 | 70 | 59.3 | 118 |
| Type B-1 | 5 | 14.3 | 5 | 14.3 | 25 | 71.4 | [1] 35 |
| Type B-2 | 7 | 14.9 | 7 | 14.9 | 33 | 70.2 | [1] 47 |
| Total | 42 | 21 | 30 | 15.0 | 128 | 64 | 200 |

[1] Odd numbers due to one pair of goggles, including type B-1 before one eye and type B-2 before the other.

### DEPTH PERCEPTION

There was practically no effect on depth perception. Forty-nine cases showed impairment by an average of 6.6 millimeters. Thirty-nine showed improvement by an average of 5.6 millimeters. Neither was there a marked difference between types of goggles as shown in Table II.

TABLE II.—*Effect of goggles on depth perception*

| Type | Impairment | | | Improvement | | |
|---|---|---|---|---|---|---|
| | Number of cases | Per cent | Average impairment | Number of cases | Per cent | Average improvement |
| | | | *mm.* | | | *mm.* |
| A | 31 | 52.6 | 6.4 | 19 | 32.2 | 5.3 |
| B-1 | 8 | 44.4 | 8.9 | 9 | 50.0 | 6.2 |
| B-2 | 10 | 43.5 | 5.4 | 11 | 47.8 | 5.7 |
| Total | 49 | 49 | 6.6 | 39 | 39 | 5.6 |

In only five cases was the reading increased to disqualifying figure, becoming 34, 40, 26, 49, and 44 millimeters, respectively. In one case a disqualifying average of 30 millimeters was reduced to 12 millimeters by wearing a pair of type A goggles.

It is impossible to explain improvement in depth perception except by more careful attention while wearing goggles and the fact that readings with goggles were always taken after the examination without goggles, thus insuring greater familiarity with the technique of the test.

### LATERAL BALANCE AT 6 METERS

There was no indication that goggles produce any marked alteration of lateral poise at 6 meters. In no case was a disqualifying amount of esophoria or exophoria produced by either type of goggles.

There seems to be a difference in the types of goggles tested as regards the tendency to produce a relative esophoria or exophoria. This is shown graphically in Table III. Relative esophoria includes cases in which an existing exophoria was reduced as well as those in which an esophoria was increased. Relative exophoria has an analogous significance. In no case did this relative change exceed two prism diopters.

TABLE III.—*Effect of goggles on lateral balance*

| Type | Relative esophoria | | No effect | Relative exophoria | |
|---|---|---|---|---|---|
| | 2 diopters | 1 diopter | | 1 diopter | 2 diopters |
| | *Per cent* | *Per cent* | *Per cent* | *Per cent* | *Per cent* |
| A | 5.1 | 27.1 | 44 | 23.8 | 0 |
| B-1 | 5.6 | 11.1 | 44.4 | 27.7 | 11.1 |
| B-2 | 0 | 13.0 | 17.5 | 52.1 | 17.4 |

The inference to be drawn is that there is a definite tendency to the production of a relative exophoria by type B–2 as compared to types A and B–1 in which there is no constant tendency. The correct explanation, however, lies in the absence in the decentered lenses of type B of the esophoria caused by the refraction of the two flat lenses in type A which usually have an angular relationship which produces mesial refraction and therefore ocular convergence for parallel rays.

### HYPERPHORIA

It was not demonstrated that goggles produced vertical imbalance to any appreciable degree. Disqualifying degrees of hyperphoria developed in only four cases, amounting to 1, 1, 1.25, and 1.50 diopters, respectively.

An interesting finding was the fact that of the 68 cases in which the goggles changed the findings, 48 caused a relative left hyperphoria as compared to the 20 cases in which the tendency was toward relative right hyperphoria. This may be significant as explanatory of the preponderance of left hyperphoria over right hyperphoria so often found and which appeared in this series. While 43 of the cases showed left hyperphoria (without goggles) only 21 showed right hyperphoria.

### LATERAL BALANCE AT 33 CENTIMETERS

There was a definite tendency to increase the exophoria at 33 centimeters. In 27 cases the exophoria was reduced an average of 2.7 diopters, and in 56 cases it was increased an average of 2.8 diopters. In 17 cases the exophoria was increased beyond allowable limits. This effect was least in type B–2, 47.9 per cent, as compared to 52.5 per cent in type A and 77.8 per cent in type B–1.

The explanation lies in the greater decentering in type B–2. As the decentering decreases there will be increasing refraction in the two lenses causing an apparent proximation of the object light and greater relative exophoria.

### PRISM DIVERGENCE

In no case was the prism divergence altered to disqualifying degree. Taken as a whole, the series indicated no significant changes. In 33 cases the prism divergence was reduced. In 35 it was unchanged and in 32 it was increased.

However, analysis indicates that there is considerable difference between types of goggles.

TABLE IV.—*Effect of goggles on prism divergence*

| Type | Decreased | Unchanged | Increased |
|---|---|---|---|
| | *Per cent* | *Per cent* | *Per cent* |
| Type A | 39.0 | 39.0 | 22.0 |
| Type B–1 | 22.2 | 33.3 | 44.5 |
| Type B–2 | 26.0 | 26.0 | 48.0 |

The indication is that the decentered lenses in type B have a definite tendency to increase prism divergence. This conforms to the principles involved. The divergence produced by the rotary prisms will be augmented by the flat lenses because of the prismatic action of the lenses themselves. This effect being removed by decentering the lenses of the goggles, there will be greater opportunity of increasing prism divergence by increasing effort. Thus the analysis discloses that pilots wearing type B lenses are able to preserve or

increase their diverging power to a greater degree than those wearing type A goggles.

Aside from the definite indication that service types of goggles produce little or no distortion of vision, the outstanding finding in this analysis is the demonstration that curving the lenses to conform to the arc of ocular rotation is decidedly advantageous. The effect of thus preserving the right angle of incidence of the line of vision at all angles produces relief of esophoria at 6 meters, less increase of exophoria at 33 centimeters, and less reduction of prism divergence.

## Summary

1. One hundred naval aviators and aviation pilots were examined with and without the goggles which they habitually wore in flying.

2. They were examined as to visual acuity, depth perception, Maddox rod screen test at 6 meters and 33 centimeters, and prism divergence.

3. Practically no distortion of vision is produced by wearing three types of service goggles.

4. Decentered lenses are a distinct advantage.

## References

(1) Davis, R. G.: Aviation Hygiene, Nav. Med. Bul., 25, 4, p. 832.

(2) Bauer, L. H.: Aviation Medicine, 1926, p. 155.

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# HYPERPHORIA

By J. D. Benjamin, Lieutenant, Medical Corps, United States Navy

Prior to the use of the strict physical examination for aviation, the word hyperphoria was seldom used by laymen or medical men, except by those specializing in eye work. There was little use for the term. Hyperphoria did not and does not, to any great extent, handicap any layman in any pursuit in which he may be engaged. Eye examiners seldom search for this condition and it is little known or understood by medical men.

During the World War aviation began to come into its own by reason of the advantage gained by the side having the superior air force. Hence medical men began to study aviation and succeeded in convincing the military authorities that aviation was a medical as well as a mechanical problem. Because acuteness of vision plays such an important part in flying, the eye came in for special attention. It was soon seen that normal visual acuity, that is, ability to read the 20/20 line, was not all that was necessary. The muscles of the eye were found to be important. As a logical sequence, hyperphoria began to have great importance attached to it.

Hyperphoria is defined by DeSchweinitz as "a tending of the visual line of one eye (right or left) in a direction above its fellow, constituting, as the case may be, right or left hyperphoria." It is found by placing a rotary prism and a Maddox rod before the non-sighting eye of the subject and, with both eyes open, having him look at a small light at a distance of 20 feet. He will then see the light with the sighting eye and will see a line in the horizontal position with the other eye. He is then told to make the line cut the light or pass through the center of it. This is done by turning the thumbscrew which is attached to the rotary prism. The amount he turns the prism is recorded on the scale. If the scale records more than 0.75, or more than three-fourths of a diopter, he is considered disqualified for aviation. In other words, he is not believed to be a safe risk but is considered a potential crash.

Why should hyperphoria by its presence make one consider an aviator a potential crash? To quote from Bauer:

> One of the first things we must know when we find a defect of muscle balance is the strength of the opposing group of muscles. Of all the conditions met, hyperphoria is the most serious, for we have here no opposing group of muscles. Consequently, it is believed that a hyperphoria of more than 0.5 diopters should disqualify except in the case of a trained flyer, when a defect of one diopter may be accepted.

During the first four years in which the prescribed physical examination now in use in the United States Navy for aviation was in effect more than 0.5 of a diopter of hyperphoria disqualified. For the last year this has been modified to the extent that more than 0.75 diopter of hyperphoria is necessary to disqualify, except that in the case of qualified flyers one diopter will be allowed.

That hyperphoria is so common among aviators as facts and figures prove it to be, is surprising. Aviators are picked physical specimens. They are as nearly perfect physically as frequent physical examinations and corrective measures can make them. Weeding out processes are constantly in effect to discard the physically unfit. Hence its presence can hardly be laid to poor physique.

As the Manual of the Medical Department of the United States Navy prescribes that three-fourths diopter of hyperphoria disqualifies, it becomes the duty of flight surgeons to disqualify prospective aviators that otherwise appear to be very desirable types. Let us take a typical case. The student has never heard of hyperphoria. He has had no difficulty heretofore in passing any physical test. He has never worn glasses. His eyes have never bothered him in any way. Hence, he begins to wonder what it is all about. He questions the flight surgeons. He consults oculists and eye specialists on the outside (civilian life) and is told by them that his vision is perfect. It usually is, so far as reading 20/20 is concerned.

There is very little to be found in the literature regarding hyperphoria. An article by F. E. Woodruff, which appeared in the November, 1925, issue of the American Journal of Ophthalmology, showing the comparative frequency of hyperphoria among people being refracted, is quoted in part below, after which will be shown the relative frequency of hyperphoria among prospective student aviators and aviators in the United States Navy.

Woodruff said:

In order that I might have some idea of the frequency with which hyperphoria was found and corrected by the ordering of correcting prisms I asked three or four of our leading opticians to select from their last thousand prescriptions those which called for prisms base up or down.

One optician reported 7 prescriptions out of 1,000; another reported 9 prescriptions out of 1,000; the third reported 24 prescriptions of out 1,000.

Out of 1,000 prescriptions from my own files, taken alphabetically, there are 19 cases of vertical muscle imbalance.

For distance and reading in those not presbyopes there are four cases of right hyperphoria and five of left hyperphoria. For reading among presbyopes there are three cases of left hyperphoria. For distance use only there is one case of left hyperphoria. For distance and reading in presbyopes there are four cases of left hyperphoria and two of right hyperphoria.

Thorington says under the heading of hyperphoria: "In the consideration of vertical diplopia, which is always a condition of crossed diplopia, never homonymous diplopia, the eye which is deviated upward is spoken of as the hyperphoric eye."

Since a homonymous diplopia is produced by trouble in the external recti or the superior or inferior obliques and hyperphoria is, according to Thorington, always a heteronymous diplopia and the levators and the depressors are the muscles involved, we are forced to the conclusion that hyperphoria is the result of impaired functions in the superior or inferior recti or in both a superior and an inferior rectus.

In order that there may be uniformity in classification I have put the entire prism over the right eye in these prescriptions and find that there are four cases requiring prisms only.

There are 8 cases of hyperphoria among hyperopes.

There are 3 cases of hyperphoria in hyperopic astigmatism.

There are 29 case of hyperphoria in compound hyperopic astigmatism.

There are no cases in myopia.

There is 1 case of hyperphoria in myopic astigmatism.

There are 3 cases of hyperphoria in compound myopic astigmatism.

There are 8 cases of hyperphoria in mixed astigmatism.

In placing all of the prisms over the left eye the classification is about the same.

There are 3 cases of hyperphoria with prisms only.

There are 10 cases of hyperphoria in hyperopia.

There are 5 cases of hyperphoria in hyperopic astigmatism.

There are 30 cases of hyperphoria in compound hyperopic astigmatism

There are no cases of hyperphoria in myopia.

There is 1 case of hyperphoria in myopic astigmatism.

There are 3 cases of hyperphoria in compound myopic astigmatism.

There are 4 cases of hyperphoria in mixed astigmatism.

The number of cases of compound hyperopic astigmatism is largely in excess. In fact, these cases outnumber all of the others combined. This fact I am unable to explain.

From the above facts it will be seen that the cases of hyperphoria ran from seven-tenths of 1 per cent to 3 per cent, or an average of about 2 per cent. This compares favorably with the figures given below, which show that 2½ per cent of aviators were found to have disqualifying amounts of hyperphoria.

Pensacola is the beginning point for all naval and marine aviators, for here they get their training and go through the stages of prospective student, student aviator, and, finally, qualified naval aviator. Since late in the year 1922, when aviation physical examination Form No. 1 was adopted, file records of all officers and men undergoing aviation training have been kept. Also copies of forms sent from other stations and forms made on qualified aviators are on file. Two different groups of these forms have been examined. These forms, as has been said, comprise prospective student aviators who never reached Pensacola, student aviators, and aviators. These examinations have been sent in from all parts of the Navy and the examinations represent the combined work of all the flight surgeons of the Navy and some of the Army. Hence allowance must be made for inaccuracy. Some flight surgeons are more lenient than others and allow all border-line cases to pass. Others are more strict and will reject all cases in which there is any question of doubt.

In the first group examined, out of 724 forms of physical examinations, 294 showed hyperphoria in some amount or other. That constitutes 40 per cent of the number examined. The low percentage of disqualifying cases is due to the fact that these people had been examined before. Any cases having disqualifying hyperphoria on original examination were eliminated before reaching this station.

The scale on the rotary prism whereby the hyperphoria is recorded is gauged only in diopters. The distance, when the pointer is between diopters, must be judged by the naked eye unless one uses a magnifying glass. This is of some help but is not an absolutely accurate method. Where a fraction of a diopter is concerned it is not easy to say whether it is 0.50 or 0.60. A scale more delicate than the present one should be devised. Preferably it should record in tenths of a diopter. It has been the writer's policy in making this test to give the aviator the benefit of the doubt if the scale records close to 0.75, providing, of course, that the aviator shows no marked deviation from normal in any of the other eye tests. (It must be added that since writing this article a scale has been devised which is more deli-

cate than the one mentioned above, and hence more accurate, but it is not available for the writer's use.)

In this second group of examinations, 2,404 examination forms were gone over and checked. These represent physical examinations of 1,345 officers and 606 enlisted men, or a total of 1,951 people examined. As has been said before, these forms comprised all groups. Of this number approximately 40 per cent again showed some amount of hyperphoria. Out of 2,404 forms, 1,409, or 58.6 per cent, failed to show any hyperphoria. In 21, or 0.9 per cent, of the forms no record was made of an examination for hyperphoria. Left hyperphoria occurred in almost twice as many cases as right hyperphoria, there being 624 cases of left hyperphoria and 350 cases of right hyperphoria. In other words, 25.9 per cent of all examinations showed left hyperphoria and 14.6 per cent showed right hyperphoria.

It has been previously stated that more than 0.75 diopter of hyperphoria disqualifies for naval aviation students. In this group of 1,951 students and aviators, 49, or 2½ per cent, had more than the allowed amount and hence were disqualified. Out of the 2,404 examination forms, 54, or 2.2 per cent, showed disqualifying amounts.

It must be remembered that some aviators were examined more than once; in fact, this group showed five reexaminations. The highest amount of hyperphoria recorded was 5 diopters. This appeared in only one case. Then 3.5 diopters was found in 1 case; 3 in 2 cases; 2.25 in 1 case, 2 in 5 cases; 1.75 in 2 cases; 1.5 in 10 cases; 1.25 in 3 cases; and 1 in 23 cases. In addition to these disqualified cases, 39 other people showed 0.75 diopter. These 39 are 2 per cent of the total examined. This amount added to the 2½ per cent disqualified would make approximately 4½ per cent of the cases who had either border-line or disqualifying amounts of hyperphoria.

Is hyperphoria variable? That is, is it present at all times in a known subject or does it appear and then disappear, to appear again? From the forms on file here it appears that it is variable. They show that it can vary from zero to 1.5 diopters in the same subject. Numerous examinations made by the same and by different flight surgeons over a period of three years show its presence at times and its absence at others in the same aviator. One classic case on file had a variation of 0.75 to 1.5 diopters. He was so anxious to fly that he underwent hospitalization for 77 days to overcome the hyperphoria. At the end of the hospital treatment he showed zero hyperphoria. He returned to flying and the hyperphoria soon became manifest, but he was allowed to fly and is still flying. Incidentally, he is considered an excellent pilot.

Does hyperphoria vary as to the side, in other words, does a person having left hyperphoria always have left hyperphoria, or does

it sometimes become right? To show how left and right hyperphoria is determined let us quote from the Manual of the Medical Department, United States Navy: "The number of prism diopters read from the scale is recorded as right hyperphoria if the prism is base down before the right eye or base up before the left. It is recorded as left hyperphoria if the prism is base up before the right eye or base down before the left." In this series of 2,404 examinations, 21 cases, or nine-tenths of 1 per cent showed left hyperphoria at one time and right hyperphoria at another. There are so few cases showing this changing hyperphoria that it is possible the mistakes may have been made by the examiners.

The factor of age seems to have nothing to do with the subject. From the examination of the charts it does not seem to appear any more frequently in older aviators than in younger ones. If anything, it is more pronounced in the younger ones. Of course, this is readily answered by saying that the older ones are not still in aviation if they have disqualifying hyperphoria. But many of the older aviators are still flying if the hyperphoria in their case is not of a degree marked enough to disqualify. The ones with hyperphoria over the limit are of course out of aviation.

The question as to whether small amounts of hyperphoria might be fatal to an aviator was considered. The physical examination forms of 27 aviators who have since been killed in crashes were examined. Of these 27 aviators, 9 failed to show hyperphoria at any time and the other 18 showed it in small amounts, never over 0.5 diopter. Thus it can be said that small amounts have no effect on flying.

What is the cause of hyperphoria? Duane says:

Hyperphoria in a great many instances is caused by paresis, or at least insufficiency, of one of the elevator or depressor muscles of the eye. In this case the deviation of its evidences (vertical diplopia, etc.), increase and decrease characteristically in looking in some particular direction of the gaze. Hyperphoria of high degree and real vertical squint (hypertropia and hypotropia) are almost always of this origin, being, therefore, noncomitant deviations.

In some cases, even when thus originating, a hyperphoria or vertical squint may become nearly comitant by virtue of consecutive contracture of the opponents of the paretic muscles.

In a few instances with very high degree of hyperphoria a true vertical squint may be truly comitant from the start—i. e., we can find no evidence of insufficiency of any elevator or depressor muscle. Hyperphorias of low degree are usually comitant.

Some cases of hyperphoria seem to be spasmodic in origin, changing rapidly, and lasting only a short time. Sometimes a spasmodic hyperphoria of this sort seems to be due in some way to accommodative action, since it disappears apparently as the result of the correction of a refractive error. In most cases hyperphoria once developed lasts indefinitely. It does not, as a rule, tend to increase, except in the form due to marked paralysis of an elevator or de-

pressor where the deviation is often exaggerated as time goes on, either by secondary contracture of the opposing muscles or because the paretic eye fixes and the sound eye hence deviates excessively.

De Schweinitz says:

Whether the hyperphoria is due to overaction or underaction of one or other set of muscles may be determined by examining the rotations of the eyes. Excessive upward rotation would naturally indicate overaction of the elevators of the hyperphoric eye, and excessive downward rotation overaction of the depressors. Deficient upward or downward rotation would indicate underaction of the vertical muscles, and in these circumstances diplopia is readily elicited, as it is in paretic conditions, by carryng the test light in the direction of the action of the affected muscle. Hyperphoria usually does not tend to increase, and therefore binocular fixation is usually retained, and it is comparatively rare for hyperphoria to pass into hypertropia.

Full correction of hyperopia disturbs the relative range of accommodation and convergence and may cause exophoria (convergence-insufficiency—relative insufficiency of the interni, according to Risley). The same condition is seen in myopes who do not use glasses at close ranges and in presbyopes whose reading glasses are too strong. Suitable glasses, or a modification of the glasses, and sometimes exercises with prisms, will relieve the condition.

To quote further from De Schweinitz regarding the relative frequency of hyperphoria, he says:

Faulty directing power of the rectal muscles (hyperphoria) is usually stated to be the least common of the anomalies (eye-muscle defects), but is much more frequent than was once supposed, and according to Hansell and Reber will be found in one-third of the cases of refractive anomalies. Many of these hyperphorias, however, are temporary in character and require no treatment except correction of the refraction and any underlying constitutional condition. The power of hyperphoria in causing asthenopic symptoms is of paramount importance, and, according to Steubens, its rôle in disturbing the action of the lateral muscles is significant.

*Symptoms.*—None of the cases in this series complained of any symptoms. This may have been due to the fact that they were either aviators or prospective aviators and were anxious to continue flying, hence made no complaints. De Schweinitz classifies the symptoms under two classes, viz., ocular and general. Headache, vertigo, insomnia, and reflex neurosis seem to be most often noticed. He says in part:

Many instances of remarkable nervous disturbances are associated with heterophoria, especially hyperphoria (as well as with refractive error) and cure will often follow the relief of the ocular difficulty. Unfortunately, the whole matter has not always escaped exaggeration.

Duane cites four symptoms as pronounced in all classes of hyperphoria, as follows:

(1) Diplopia, (2) peculiar attitude of head often resulting in torticollis, (3) amblyopia, (4) reflex symptoms induced by the effort made to correct the deviation.

He says:

The most marked and disagreeable symptoms are found in hyperphoria and in divergence—insufficiency. In these conditions the symptoms are usually the most troublesome in distant vision.

*Treatment.*—The first thing seems to be to look after the general health of the patient. Diseased tonsils should be removed. Bad teeth looked to and taken care of, as well as any general systemic condition. This precaution seems hardly necessary in aviation, however, as aviators undergo a very strict physical examination each January. De Schweinitz says again:

The author has failed to observe relief in hyperphoria from prismatic exercises, but Savage's method has received the commendation of many competent observers, and should be tried. * * * In permanent latent deviations of the vertical muscles (right or left hyperphoria) the defect is often quite small, and usually not above 4° or 5°; hence prisms may readily be ordered for continuous use and combined with the lenses which correct the refractive error, forming a prismosphere. If, for example, there is right hyperphoria of 2°, a 2° prism base down before the right eye corrects the difficulty, or, what is equivalent, the prism may be divided between the two eyes, i. e., 1° base down before the right and 1° base up before the left. It is safe to correct very trifling errors in the vertical muscles either with prisms or by decentering the correcting lens to an equivalent degree, providing these errors are still maintained after continuous use of glasses which neutralize the refractive error.

Duane says:

Deviations of low degree may be corrected by prisms worn constantly, either alone or combined with the glass correcting the refraction. This is most serviceable in hyperphoria. * * * In hyperphoria, if noncomitant, we proceed according to the rules laid down for operative interference in paretic deviations. In a comitant hyperphoria the most successful operation is a tenotomy of the superior rectus, which should never be pushed so far as to cause the muscle to be paretic or so far as to produce even a moderate overcorrection.

## SUMMARY

Hyperphoria in small amounts is much more common than is ordinarily supposed, occurring in about 40 per cent of healthy adults. It occurs in large enough amounts to cause rejection for aviation in about 2½ per cent of healthy adults.

Hyperphoria varies in amount, probably being influenced by fatigue, rest, diet, and general conditions of health. It is questionable whether it varies from side to side; that is, right to left and vice versa. Not enough cases show this condition to make the fact certain. Hyperphoria in small amounts seem to have no bearing on fatal accidents in aviation. Age has no effect on hyperphoria. Left hyperphoria is nearly twice as common as right hyperphoria.

The symptoms amount to little or nothing in all cases seen in this series, although from the writings of others hyperphoria would seem to be a possible cause of vague cases of migraine and other nervous disturbances. There is no treatment necessary when the hyperphoria occurs only in small amounts. In large amounts prisms seem to help, and in very severe cases tenotomy has been recommended. This last, however, is a very radical procedure and should be used only as a last resort and after expert advice.

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## PREPARATION OF PATIENTS FOR FUNCTIONAL TESTS[1]

By P. F. DICKENS, Lieutenant, Medical Corps, United States Navy

Many functional tests have fallen into disrepute because sufficient care and supervision are not exercised in preparing the patient for them. If the test is to be of value to the clinician, it is essential that the patient receive preparation, and that this be the standard preparation upon which the test was originally based. This fact holds true for nearly all functional tests, and especially true for chemical analysis of the blood. No clinician at present would attempt to hazard a diagnosis on many patients without having previously analyzed the functional tests done. These tests are of value only if performed under uniform conditions, otherwise they are a menace, leading to wrong conclusions or to a false sense of security. It is essential that we have some idea of the functional capacity of an organ before a correct conclusion may be reached as to its ability to "carry on."

It is best to choose that test which puts some strain upon the organ under observation, in order to obtain more accurate knowledge of its reserve power. The functional tests do not make a diagnosis for the clinician as to the type of underlying pathology in the organ, and the biochemist can only state that, at the time the test was performed, certain substances in certain definite quantities were present. It must be emphasized that the laboratory can only report findings and the best results can be obtained when the laboratory and clinician work in collaboration. It is an untenable undertaking for the biochemist to make a pathological diagnosis in most instances, except by inference. The result of a functional test is a symptom for the

[1] Read at the faculty meeting, United States Medical School, Washington, D. C.

clinician to take into consideration in arriving at a diagnosis, and he should not allow himself to be stampeded into this diagnosis by the laboratory.

It is the purpose of this paper to point out to the clinician that, if results of any value are to be obtained from most functional tests and biochemical examinations, it is necessary that the test be performed on material obtained under standard conditions, and that these results must be interpreted in connection with the symptoms present. Lastly, let us add that, if functional tests are performed and material obtained for examination under uniform conditions, the value of these tests immediately becomes apparent. This is believed to be the reason why certain tests are held of value in some clinics while the same tests are in disrepute in others.

The method of preparing the patient or of obtaining material for examination in a few of the more common tests or examinations follows:

### KIDNEY FUNCTION TESTS

#### *Mosenthal test*

(1) Patient to receive the usual diet on the day of the test, also the day before the test.

(2) Patient to empty bladder immediately before breakfast (8 a. m.) day of test. (This to be discarded.)

(3) Collect specimens at 10 a. m., 12 noon., 2 p. m., 4 p. m., 7 p. m., and 10 p. m. Each specimen to be collected in a separate container, properly labeled with the hour of collection.

NOTE.—The 10 p. m. specimen must not be collected less than three hours after the evening meal has begun.

(4) Collect all urine from 10 p. m. to 8 a. m. the following morning. This specimen to be in a separate container and labeled "8 a. m. specimen."

#### *Concentration test*

(1) Patient to receive no fluids following the evening meal before the test and no food between meals until the test is finished. No fluid during test.

(2) 8 a. m. (day of test): Have patient empty bladder. (This to be discarded.) Collect urine in separate containers every three hours thereafter until night—that is, at 11 a. m., 2 p. m., 5 p. m., and 8 p. m. These containers to be labeled with the collection hour. Then collect all urine from 8 p. m. to 8 a. m. next morning, this collection to be made in one container and labeled "Overnight specimen."

(3) 8 a. m., breakfast (day of test): Dry cereal with sugar, sirup, or honey (no milk); one egg; toast or bread with butter.

(4) 12 noon, dinner (day of test): Roast beef, steak, or chops; potatoes (boiled, baked, or riced); bread and butter; jam.

(5) 5 p. m., supper (day of test): Two eggs; bread and butter: jam.

*Dilution test*

(1) 8 a. m. (day of test): Have patient empty bladder (this to be discarded), and give 1,500 c. c. of water to drink. This water to be consumed within 30 minutes.

(2) Collect urine in separate containers at 8.30—9—9.30—10—10.30—11—11.30 a. m., and 12 noon, eight specimens in all. Each labeled with the collection hour. Collect all urine from 12 noon to 8 a. m. next morning in one container labeled "Noon to 8 a. m. specimen."

(3) Omit breakfast.

(4) For dinner and supper give the routine nephritic diet or the diet to which the patient has been accustomed.

(5) Permit one glass of water after supper.

*Phenolsulphonephthalein test*

*Intravenous injection.*—(1) Patient to receive 400 c. c. of water 30 minutes before intravenous injection.

(2) Patient to empty bladder just before the dye injection. This specimen to be labeled "Urine for control" and sent to the laboratory.

(3) Inject with a small syringe exactly 1 c. c. of the dye.

*Collection of urine.*—(1) If the appearance time is not wanted, collect specimens of urine in 15, 30, and 60 minute periods after the injection of the dye. Collecting in separate containers, labeled "15, 30, and 60 minute specimens," respectively.

(2) Should the appearance time be desired, the patient is to be catheterized, catheter remaining in place and emptying into a test tube containing 1 c. c. of a 10 per cent sodium hydroxide solution. The first pink color that remains permanent for 30 seconds denotes the appearance time. This catheterized urine is to be saved and added to the specimen labeled "15-minute specimen."

(3) Should the patient be unable to void at the specified time he should be catheterized.

*Ureteral catheterization.*—(1) Inject the dye after the catheters are in place.

(2) Specimens should be carefully collected and each should designate the kidney from which obtained.

(3) Appearance time may be obtained as above.

*Intramuscular injection.*—(1) Patient to empty bladder before injection of the dye. This specimen to be labeled "Urine for control" and sent to the laboratory.

(2) Patient to receive 400 to 500 c. c. of water to drink immediately before injection.

(3) Inject into the lumbar muscle exactly 1 c. c. of the dye.

(4) Allow 10 minutes for the absorption of the dye. The first specimen is to be collected 1 hour and 10 minutes after the injection, and the second specimen 2 hours and 10 minutes after the injection. These specimens to be labeled "First and second hour specimens," respectively.

(5) If the appearance time is desired, the same procedure may be employed as under Intravenous injection, paragraph 1 (Collection of urine). The catheterized specimen so obtain is to be added to the first-hour specimen.

*Normal values.*—Intravenous injection: Normal appearance time, 4 to 6 minutes; normal elimination, 35 to 40 per cent during first 15 minutes; 15 to 25 per cent during second 15 minutes; 10 to 20 per cent during second 30 minutes. Total for 30 minutes, 50 to 65 per cent; total for 60 minutes, 60 to 85 per cent.

Intramuscular injection: Normal appearance time, 10 to 15 minutes; normal elimination, 40 to 60 per cent during first hour, 10 to 25 per cent during second hour. Total for 2 hours, 60 to 75 per cent.

## GASTRIC ANALYSIS

Specimens are usually received in separate containers labeled "Fasting content (residuum)" and "Ewald test meal."

### *Methods for collection of gastric analysis specimens*

NOTE.—Patient to receive a light meal at 7 p. m., to which are added a few raisins or three prunes, and to receive no further liquids or solids until completion of the test.

(1) *Collection of residuum the following morning at 9 a. m.*—(*a*) Pass "Rehfuss tube" (precautions reference swallowing saliva).

(*b*) Completely empty stomach of residuum.

(*c*) It is not necessary or desirable to remove the tube.

(*d*) Following the above procedure give the test meal: Dry toast (2 pieces), 35 grams; water (2 glasses), 400 c. c.

(*e*) Completely empty the stomach one hour after the last intake of food (test meal).

(*f*) To empty the stomach completely it is necessary to place the patient in five positions:

1. Patient on back.
2. Patient on right side.
3. Patient on left side.
4. Patient on stomach.
5. Knee-chest position.

As a check to see if the stomach is empty, have the patient sit upright and manipulate the stomach for 5 minutes and remove contents.

(2) *Fractional analysis.*—Fifteen minutes after the last intake of food (test meal), and at 15-minute intervals thereafter, remove not less than 10 c. c. of material each time. Keep each specimen separate and mark specimens No. 1, 2, 3, etc. Continue to obtain specimens every 15 minutes for two hours or until stomach is empty.

NOTE.—Force air (10 c. c.) through the tube into the stomach after each sample is withdrawn.

## LIVER FUNCTION TEST

### *Bromsulphalein test*

The test is based on the rate of excretion by the liver of the dye injected into the blood stream.

(1) Weigh the patient and calculate the dosage of dye on the basis of 2 milligrams per kilogram of body weight. The body weight in pounds divided by 55 will give the exact quantity in cubic centimeters of the 5 per cent solution required.

(2) Inject dye slowly from a sterile syringe directly into arm vein, taking care that no leakage occurs outside the vein.

(3) Withdraw, preferably from the opposite arm, samples of blood (5 to 10 c. c.) 5 and 30 minutes after the injection, using a dry syringe and test tube.

(4) The average amount of dye present after five minutes in individuals without liver disease has been found to be 35 per cent, the amount varying between 20 and 50 per cent. After 30 minutes there should be no dye present, or only a faint trace. Any retention of dye above 50 per cent after five minutes, or presence of any dye after 30 minutes, is indication of hepatic disease.

## PROCEDURE FOR SUGAR TOLERANCE TEST

### *Killian's method*

(1) Patient to have a light supper the evening preceding day of test, with nothing to eat after 7 p. m.

(2) Breakfast at 8 a. m. as follows: 1 piece bread, 3 inches square; 1 egg; 1 cup water (NOTHING MORE).

(3) Blood sugar control to be taken at 9.30 a. m.

(4) Carbohydrate ingestion to be given at 10 a. m., as follows: Patient to get 1.75 grams of glucose per kilogram of body weight in sufficient water to make a 50 per cent solution, or in 300 c. c. of black

coffee. (A little lemon juice may be added to the aqueous solution for palatability.)

(5) Blood sugar to be taken on the following hours: 10.30—11—12—1, and every hour thereafter until the normal level has been reached as determined by the 9.30 a. m. control. *The patient should have nothing to eat until the ward has been notified by the laboratory.*

(6) A 24-hour specimen of urine is to be collected and sent to the laboratory the day before the test is to be made.

(7) A second 24-hour urine specimen is to be collected the day of the test as follows: Patient voids at time the blood sugar control is taken (9.30 a. m.); all urine up to 10.30 a. m. is voided into a separate container, and brought to the laboratory at time for taking the second blood specimen (10.30 a. m.); hourly specimens of urine are collected and brought to the laboratory when reporting for blood collections as above (11 a. m.—12 noon, etc.). After the last blood specimen is taken the urine is voided and saved up to 9.30 a. m. the following morning.

### OBTAINING FECES FOR OCCULT BLOOD TEST

To check results showing a positive occult blood in stools it is desirable that the patient receive the following:

(1) Administer 5 grams of charcoal in capsules.

(2) Begin a meat-free diet.

(3) Have patient cease brushing his teeth until test is completed.

(4) Have patient take care not to swallow blood from gum margins.

(5) Collect the specimen following the passage of charcoal and send to the laboratory for examination.

#### *Alternate method*

Should the patient receive a gastrointestinal series of examinations by X ray, he may be placed on a meat-free diet and advised against the brushing of his teeth at the time the barium is administered. Collect the stool after the barium has passed and send to the laboratory for examination.

### EFFUSIONS

(Synovial fluids, etc.)

Recent literature would indicate that in noninfective effusions the sugar content of the effusion parallels that of the blood. In infective effusions the sugar content is low.

*Procedure*

(1) Collect 10 c. c. of effusion in an oxalate-free flask.

(2) Collect 10 c. c. of venous blood (oxalated) at the same time for use as a control.

(3) Sufficient synovial fluid for an albumin determination should be forwarded to the laboratory with the specimen for the sugar determination.

(4) Most surgeons require that a cell count be done on all effusions.

### SUGAR AND CHLORIDE DETERMINATION ON SPINAL FLUID

*Procedure*

At least 5 c. c. of the spinal fluid (blood free) should be collected (after a 12 to 14 hour fast) in a clean, dry test tube and forwarded to the laboratory for this test.

### PREPARATION OF PATIENT FOR DETERMINATION OF BASAL METABOLISM

Basal metabolism is the minimal heat production measured 12 to 18 hours after ingesting food and with the patient at complete muscular rest.

To prepare the patient for the test the following technique is advised:

(1) On the day preceding the test the subject should have a light supper and retire early in order to be thoroughly rested in the morning.

(2) On the morning of the test the patient remains in bed until brought to the metabolism room, breakfast being withheld.

(3) The subject should defecate and urinate, if possible, before coming to the metabolism room.

(4) The patient should be brought to the metabolism room on a wheel chair or litter.

(5) The patient should rest quietly for one-half hour before beginning the test, conversation being avoided during this period.

*Interpretation of report*

(1) The basal metabolic rate is increased chiefly in hyperthyroidism, leukemia, and primary or secondary anemia when the Hb. is below 20 per cent. Also by fever, chills, ingestion of food, dyspnea, overfeeding, and muscular effort.

(2) It is depressed in hypothyroidism and by undernutrition and starvation.

(3) Pituitary disease may either increase or decrease the rate; hypopituitarism with obesity depressing the rate, while that type of pituitary disease with glycosuria increases the rate.

## BLOOD CHEMISTRY

### *Requesting blood work*

Blood watches are detailed from the personnel at the United States Naval Medical School, and are on duty at 7.30 a. m. on the specified days (Monday, Wednesday, and Friday).

Requests for routine blood work on bed patients should be at the United States Naval Medical School (laboratory of clinical chemistry) by 4 p. m., or not later than 4.30 p. m., of the day preceding, i. e., Saturday, Tuesday, and Thursday. This enables the laboratory and blood watch to estimate the apparatus necessary for the morning collection.

Patients other than bed patients should be at the United States Naval Medical School (laboratory of clinical chemistry) by 7.30 a. m. on Monday, Wednesday, and Friday.

When telephoning the medical school regarding blood chemistry, call laboratory of clinical chemistry, extension No. 20.

### *Time of taking blood (after 12 to 14 hour fast)*

It is quite essential that specimens be secured under as uniform conditions as possible. Fairly constant results are obtained by taking the blood in the morning before breakfast—that is, after a 12 to 14 hour fast, and before any food has been taken.

Taking the blood specimen early in the morning permits the analysis the same day, which is quite necessary in the case of most determinations.

### *Method of taking blood specimens*

(1) *Lithium oxalate solution.*—The procedure followed by this laboratory in preparing flasks containing lithium oxalate for specimen collecting is as follows:

A 2 per cent aqueous solution of lithium oxalate is prepared. (One c. c. of this contains 20 mgms. of the salt.) This is kept in a drop-bottle fitted with a calibrated dropper which delivers 20 drops to the c. c. of the solution. (Each drop represents 1 mgm. of the salt.)

Twelve drops of this 2 per cent solution (representing 10+ mgms.) are added to 50 c. c. Erlenmeyer flasks. These flasks are placed in an oven and the solution evaporated to dryness. The dried salt is

broken loose from the flasks with a stirring rod, and the flasks stoppered with rubber stoppers. They are now ready for use.

(2) *Routine blood chemistry.*—Ten c. c. of blood is drawn into a large glass syringe and immediately transferred to a 50 c. c. Erlenmeyer flask containing either 20 mgms. of potassium oxalate or 10 mgms. of lithium oxalate. (The latter is used by this laboratory.) The blood should be mixed at once with the oxalate by giving the flask a gentle rotary motion.

NOTE.—Potassium oxalate tends to give precipitates with uric acid. An excess of oxalate interferes with the tungstic acid precipitation of the proteins.

(3) *Blood sugars.*—Five c. c. of blood is drawn when this test alone is requested. The same method is employed as under (2) for blood chemistry.

(4) *Cholesterol.*—Three to five c. c. of blood is drawn and transferred to a flask containing the oxalate when this test is requested alone. When requested in connection with a routine blood chemistry in which 10 c. c. of blood has been taken, no extra blood need be drawn.

(5) *Special tests on blood serum (do not oxalate).*—The following are special tests upon the blood serum: (*a*) Calcium, (*b*) phosphorus (inorganic), (*c*) Van den Bergh (qualitative and quantitative), (*d*) icterus index (when requested in connection with a Van den Bergh no extra blood need be taken), (*e*) bromsulphalein (5 and 30 minute specimens are to be taken).

NOTE.—Ten c. c. of blood is drawn for these tests and transferred to a centrifuge tube, oxalate-free.

(6) *Plasma $CO_2$ combining power, oxygen, and carbon monoxide blood content.*—Ten c. c. of blood is drawn under oil for these tests, as follows:

Three to five c. c. of liquid petrolatum is drawn into a 20 c. c. glass syringe through a short length (5 to 6 inches) of small rubber tubing. The tubing is then clamped off with a hemostat so that the oil is retained. Remove the tubing from the syringe and transfer to a centrifuge tube containing the oxalate and 2 to 3 c. c. of liquid petrolatum.

A needle is fitted to the syringe and the desired amount of blood is drawn by venous puncture. Remove the needle and attach syringe to the rubber tubing, release the hemostat and expel the blood slowly into the centrifuge tube, making sure that the end of the tubing is under the oil. Stir immediately to oxalate the blood.

## BLOOD CHEMISTRY ESTIMATIONS

(1) *Routine blood chemistry estimations.*—When a routine blood chemistry is requested it shall consist of the following estimations:

(*a*) Nonprotein nitrogen.
(*b*) Urea nitrogen.
(*c*) Uric acid.
(*d*) Creatinine.
(*e*) Sugar.
(*f*) Chlorides.

(2) *Blood sugar estimation.*—When the blood sugar alone is wanted it is requested on the blank as "Sugar."

(3) *Special estimations.*—Special estimations are requested by name and are as follows:

(*a*) Plasma $CO_2$ combining power.
(*b*) Cholesterol.
(*c*) Calcium.
(*d*) Phosphorus (inorganic).
(*e*) Bromosulphalein.
(*f*) Van den Bergh (qualitative and quantitative).
(*g*) Icterus index.
(*h*) Carbon monoxide blood content.
(*i*) Oxygen blood content.

NOTE.—In the case of not sufficient blood being submitted for a complete routine chemistry, the following routine has been adopted: First in importance, non protein nitrogen, uric acid. Second in importance, urea nitrogen, sugars. Third in importance, creatinine, chlorides.

Should the NPN be within normal limits or only slightly above, sugars may be estimated in place of the urea.

Should the NPN be exceptionally high, the creatinine estimation should be made in place of the urea.

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## DERMATITIS EXFOLIATIVA DUE TO THE ARSPHENAMINES

### WITH REPORT OF CASES

By G. H. LARSON, Lieutenant, Medical Corps, United States Navy

Arsenic is widely used in medicine and is one of the drugs most frequently employed with suicidal or homicidal intent. Its detection is comparatively easy if suspected and its antidote has been found simple of administration. However, the symptomatology of arsenic poisoning is protean in its manifestations and, in many cases, the condition has been unsuspected until too late for the institution of beneficial treatment. Because of this fact this paper is written in an endeavor to stimulate careful observation and, especially, careful attention to previous medication history.

When the acute type of arsenical poisoning appears it is usually after the administration of large doses, given therapeutically or for ulterior purposes. The symptoms can not be said to be typical, but

the main complaint is usually referable, at first, to the gastrointestinal tract and, later, to the central nervous system, either of which complaints may predominate and thus classify the condition as to type. Many organs of the body may be involved—brain, liver, kidneys, heart, or skin—all often showing very marked congestive or destructive changes, depending upon the amount of absorption that has occurred.

In certain criminal cases arsenic may be administered in varying dosage over long periods of time and produce no outstanding symptom except a gradual depression of the vital forces and eventual death. Patients have been known to absorb sufficient arsenic from wall paper to produce serious poisoning. In these types and in other long-standing or chronic cases the peripheral nerves, skin, and mucous membranes suffer most. Wrist-drop, trophic ulcers, and skin lesions are prominent manifestations, as in the case of poisoning by some other heavy metals. It is of utmost importance that we recognize the condition and begin active treatment at once, more especially because of idiosyncrasies and peculiarly selective action on different tissues of different individuals, in order to prevent permanent damage. Where formerly all arsenic-poisoning cases were treated by neutralizing the arsenic in the gastrointestinal tract (usually only that in the stomach) by the administration of the freshly prepared hydrated sesquioxid of iron and magnesium oxid, washing out the stomach, and, thereafter, potassium iodide, elimination, and "watchful waiting," we now use a specific (12).

In the consideration of arsenical poisoning by means of that form of arsenic contained in the preparations used in the treatment of syphilis there are many factors which do not appear when arsenic is administered for other medicinal purposes. Two of these factors, and probably the most important of all, are idiosyncrasy and cumulative action. It would appear that cumulation should not be given the grave consideration once accorded it; for, if cumulation is a property of arsenic, then no credence can be placed on the well-authenticated statements of the existence of the "arsenic eaters" of the Tyrol.

Those who have observed cases of arsenical poisoning know that the patient will tolerate well several injections of large doses and then suddenly exhibit symptoms of poisoning even when the dose has been reduced. This may be due to the fact that maximal dosage is employed and saturation is the aim, in an endeavor to overwhelm the invader with minimal damage to its host. The rate of elimination of arsenic from the body is as varied as the symptoms are protean. It has been found by Hill (1) in the urine 80 days after ingestion and by Young (2) in the bones six months after termination of treatment.

In the cases to be reported here the gastrointestinal symptoms were entirely absent. This has been explained by the fact that parenteral medication was employed and, further, that in those preparations in which the arsenic trioxid is not released but the arsenic is held safely and firmly in combination, the rate of excretion by the bowel is very slow. Only two preparations were employed—arsphenamine, with a margin of safety or ratio of 17, and neoarsphenamine, with a ratio of 28 (3). Because of the absence of intestinal symptoms, which are the first to appear when the metal arsenic is the responsible agent, it becomes more difficult of recognition and it is of the greatest importance that the patient receiving arsenicals be examined with care before each injection. This may be appreciated more readily when it is noted that in one of our cases the poisoning was fatal in 36 hours after receiving approximately two-thirds of the usual dose of neoarsphenamine at his second injection, in spite of active treatment with sodium thiosulphate and means of stimulation and elimination.

The classification of the reactions following the administration of arsenicals in the treatment of syphilis is extremely difficult. Almost anything may happen. Klauder (4) outlines two groupings under the cutaneous reactions: "Erythemosquamous and vasomotor." The types of involvement are legion. Among the skin lesions are mentioned, Herxheimer reaction; purpura; herpes zoster; pigmentations; fixed eruptions; erythematous, scaly macules; sparse, diffuse, or universal erythema; vesicular, papular, or bullous eruptions; papular syphilid; psoriasis-like and pemphigoid eruptions; lichen planus-like, pityriasis rosea, seborreic dermatitis, and papular eczema; hyperkeratosis, hyperhydrosis, and erythromelalgia. These types very clearly show that the toxic effects of arsenicals may be as varied as the localization and effect of the spirochete itself, and there may be a close connection between these facts. Miller (5) states that "seborrheic dermatitis seems to predispose to postarsphenamine eruptions and sodium thiosulphate intravenously and orally greatly shortens the course of these eruptions." Klauder (4) says that, in his experience, a large percentage of dermatitis exfoliativa is due to faulty venipuncture with deposition of the drug outside of the vein and resultant local reaction. We have noted frequent depositions of the solutions outside of the veins without the production of any but local reactions. The statistics from Brazil (Araujo) (7) report two deaths in 308,185 injections and would seem to make accidents after arsphenamine a negligible factor. No mention is made of mild or moderate reactions.

E. Bruusgaard (6) states that jaundice due to arsphenamine is rare and can often be ascribed to the syphilis or intercurrent disease. He has had isolated cases arising in the course of secondary syphilis

before the advent of arsphenamine in the treatment, which now would be ascribed to arsenic. It has been our experience that the differential diagnosis of jaundice due to syphilis and that due to arsenic or cholangitis may be made in the following way: When due to catarrhal inflammation no rentgenological shadow will be seen after visualizing dye, but in jaundice due to liver-cell damage by syphilis a distinct cholecystogram is the rule after the administration of sodium tetraiodophenolphthalein. In cholangitis the Van den Bergh test shows the direct reaction; in arsenic poisoning this reaction is diphasic. The jaundice produced by antiluetic treatment with arsenic responds quickly to sodium thiosulphate medication (13), but that caused by catarrhal inflammation or syphilis is not affected by this treatment. The case reports briefly cited here contain no instance of jaundice despite the fact that in several of them the toxic symptoms were severe and one was fatal. Mitchell (7) mentions the reactions appearing most frequently as icterus, neuritis, purpura, and dermatitis exfoliativa. This has not been the case in our experience, where the latter two were encountered to the exclusion of the former.

There is some question as to the rôle that mercury plays in producing poisoning or accentuating the arsenical reaction, according to Turner (8), who states: "There is seemingly little doubt, etc., * * *," and quotes Lloyd and Gardener, Koelsch, and Ilhoefer, and others to substantiate this contention. This is difficult of refutation because of the similarity of certain symptoms when heavy metal poisoning has occurred; however, it is doubtful if mercury, per se, by mouth or intramuscularly, produces skin lesions of any type even though fatal poisoning with this metal has resulted. Haskell, Henderson, and Hamilton (10), in an experimental study of mercurial poisoning, come to the conclusion that sodium thiosulphate is ineffective in combating this condition when the mercury has entered the blood stream in lethal dosage. We have used potassium iodide, mercury, and bismuth in safety when arsenicals would produce a dermatitis and, conversely, in one case we were unable to use bismuth because of the production of a dermatitis by this metal. We eventually gave neoarsphenamine followed by sodium thiosulphate (vide infra). Miller (5) states "further treatment should be with mercury and the iodides only." He fails to mention or consider bismuth, and even though this had been mentioned as alternative treatment, we would not agree, as some of our patients who have presented hypersensitive reactions were subsequently able to take the regular treatment with neoarsphenamine if sodium thiosulphate was given when the slightest reaction resulted. We note that all cases of dermatitis exfoliativa present a varying degree of eosinophilia,

which reached 36 per cent in one case. This may be of great importance when scarlet fever must be differentiated. Szandicz (11) reports that patients who are hypersensitive to arsphenamine present an immediate hyperemia of the conjunctiva. He noted the redness limited to one eye and lasting for 15 minutes. In addition, he states that there are persistent joint pains and ascribes this symptom to intolerance also. If these findings are substantiated by further observation, we have a valuable means of avoiding the more severe reactions that further treatment entails when these warnings go unheeded. There is usually no warning and the first indications have been acute, full-blown eruptions or, generally, a keratogenous eruption first noticed on the softer skin areas, such as the cubital and popliteal spaces, and greatly resembling a patchy ichthyosis.

According to Kuhn and Reese (12), sodium thiosulphate apparently has the power of protecting the kidney from injury and of restoring it to normal function when injured by the arsenicals. Dennie and McBride (13) ascribe almost magical qualities to this chemical in the treatment of poisoning by any of the heavy metals belonging to certain groups which are capable of being precipitated by sulphur. Their premises have been refuted by several workers, among whom are Haskell, and cited by him Greenbaum (14), Schamberg, Michael, and Cole, especially in regard to its effect on mercurials. Greenbaum (14) has cited the pharmacology of certain sulphydryl compounds, especially in regard to the precipitation of some of the heavy metals, and notes that, although sodium thiosulphate and thiosinamin do not belong to the (SH) radicle group, thiosinamin has the greater power of neutralizing the effect of the heavy metals after poisoning. Inferentially, this is because sodium thiosulphate is used as a reducing substance in the preparation of arsphenamine, and also because the sulphur is much less firmly held in the thiosinamin than in the thiosulphate and therefore is more available and efficacious. He makes a plea for the more frequent use of thiosinamin.

Before proceeding to outline the case histories and treatment for which this partial review of the literature has been the preamble, it is desired to mention the most interesting and bizarre reaction of the entire field of anaphylactic medicine, the Herxheimer or Jarisch-Herxheimer reaction. The Herxheimer reaction, according to Houghton (15), may be defined as an aggravation of pathological processes in syphilis following specific therapy. It is simply an accentuation of the eruption, with constitutional symptoms manifested and produced by specific treatment, whether by mercury or one of the arsenicals, and explained as being due to the action of the specific on hypersensitive cells. The present conception of this

reaction has been elaborated by Ehrlich, who stated that it was probably caused by the toxins liberated by the lytic action on the *Spirochetæ pallida.* There are numerous other theories of the mechanism by which this phenomenon is produced and it serves as an excuse for major injuries, such as aneurysmal rupture, acute yellow atrophy of the liver (3), epileptiform convulsions, acute suppression of urine, sudden cardiac or cerebral deaths, tingling of the extremities, and gangrene (19). It has also been used to explain the mechanism of the provocative Wassermann reaction which has recently been the target of the skeptic as being a medical myth.

"Nitritoid crises" may well be considered at this time, as they unquestionably belong to allergic phenomena. They have been considered in connection with urticaria and were named because of their resemblance to poisoning by amyl nitrite by Milian (16). Klauder (4) considered nitritoid crisis a colloidal reaction. Rosen, Muller, and Myers (21) explain nitritoid crises on the basis of a direct influence on the autonomic nervous system and its para-sympathetic part. Thus a depletion of leukocytes in the peripheral blood vessels results. They state that epinephrin prevents the leukopenia and the associated angioneurotic syndrome. We have used epinephrin with thiosulphate in treatment of dermatitis exfoliativa but no attempt has as yet been made to evaluate its influence. We do not consider it of particular value in the purely dermatological cases. It would probably be of value in those cases allied to angioneurosis, such as urticaria and "nitritoid crises."

Recently, Frazier (18) cites two cases in which sodium thiosulphate is given as the cause of extremely severe dermal, kidney, lung, and pleural reactions. He draws no conclusions but infers that the thiosulphate is the responsible agent. It appears that the evidence is insufficient and a more reasonable cause of these injuries might be found in hypersensibility to the arsenical used. The dosage of thiosulphate used by him might be described as minute, as we have given an initial dose of 1 gram, and in the next 24 hours 5 additional grams, with no deleterious effects.

In view of the manifold pathological conditions which may be produced by the arsenicals used in the treatment of syphilis and the variable individual tolerance, it is not practicable to prescribe a routine treatment, but the first endeavor must be neutralization of the poison in the tissues. This seems to be obtained by the intravenous administration of 1 gram of thiosulphate in 10 cubic centimeters of sterile distilled water in order to note any untoward effect and, thereafter, comparatively large doses. As has been stated, we have given 5 grams at one dose without harmful effect. In the types of weeping dermatitis, starch baths and alkaline solutions and

unguents to obviate the crust formation, seem to be grateful to the patient.

## CASE REPORTS [1]

*Case 1.*—W. H. K., Sea. 2c., white, male, 26 years old. Admitted following the fifth intravenous administration of 0.9 gram of neoarsphenamine. He had a brawny desquamation of the extremities and marked general edema. W. B. C. 8,100. Eosinophiles, 32 per cent. Temperature septic. In a few days the desquamation became general, casts of the hands and feet came away. He responded promptly to sodium thiosulphate in 2-gram doses each 24 hours.

*Case 2.*—W. C. M., Sea. 2c., white, male, 24 years old. Admitted following the second intravenous dose of 0.6 gram of neoarsphenamine. He had intense frontal headache, chills, vomiting, lumbar pains, conjunctivitis, and a generalized scarlatiniform skin eruption. Eosinophilia of 4 per cent. Urine showed albumin and casts. One week's treatment with sodium thiosulphate, up to 3-gram doses in 24 hours, promptly cleared up the condition.

*Case 3.*—F. C., M. Att. 1c., Filipino, 21 years old. Admitted with a marked general, dry, scaling eruption and severe herpes labialis and edema about the eyes. He had had a typical asthmatic attack on a previous admission and his routine Wassermann was found to be 4+. After getting five injections of neoarsphenamine the above phenomena ensued. Urinalysis showed many casts, R. B. C., and albumin. The dermatitis became more severe, weeping and encrustation developed, and for several weeks he received sodium thiosulphate in doses of 2 grams daily and, in addition, starch baths and soda bicarbonate ointment. Eosinophilia, 12 per cent.

This patient had three distinct attacks upon persisting in the treatment, the last one following the use of bismuth, and the treament eventually employed was neoarsphenamine with injections of sodium thiosulphate as a prophylactic measure. He was on mercury and KI for several weeks with no untoward results.

*Case 4.*—B. Y., Filipino, male, 24 years old. Admitted following the initial dose of 0.4 gram of neoarsphenamine with a generalized papular eruption and facial edema. Urinalysis indicated acute nephritis. The eruption soon became dry with brawny desquamation. Icterus index normal. This was considered a very mild case. He was given 1 gram of sodium thiosulphate daily for seven days, when the urine was negative. Subsequent treatment was with bismuth, potassium iodide, and mercury, with good results and no untoward symptoms.

*Case 5.*—M. T. C., white, male, 22 years old. Admitted following the third intravenous administration of neoarsphenamine with a generalized scarlatiniform eruption. Mild attack. The lesions never progressed to vesiculation or weeping and he was clear in four days. In many of the moderate reactions to arsenicals, scarlet fever must be differentiated and it may require the therapeutic test of sodium thiosulphate. It is suggested that the presence of an eosinophilia is important as a differential factor, although the presence of some concurrent disease may confuse.

*Case 6.*—J. G., Sea. 2 c., white, male, 19 years old. Admitted following the second intravenous administration of neoarsphenamine. The first "shot," 0.45 gram, given (April 20, 1926) resulted in a moderate reaction, which kept him off duty for 24 hours. The second, of 0.60 gram (April 27, 1926), produced a severe reaction in which he developed epileptiform convulsions six hours afterward and was admitted comatose. Examination including spinal puncture

[1] Cases reported from U. S. Naval Hospital, Pearl Harbor, Hawaii.

showed evidence of hemorrhagic encephalitis. He was given 0.5 gram of sodium thiosulphate within 20 minutes of his admission and 2 additional grams within the next 24 hours, but died in convulsions 36 hours after receiving his neoarsphenamine. A scarlatiniform and petechial generalized eruption was present. Temperature varied from 102° to 107°. Eosinophilia was present. Catheterized specimen of urine showed evidence of acute nephritis. Sodium thiosulphate in massive doses might have given a happy result as indicated by McBride (20).

*Case 7.*—M. J. P., white, male, 20 years old. Admitted following the sixth intravenous administration of neoarsphenamine, with temperature 102°, edema of feet, generalized maculopapular eruption. The eruption soon became vesicular and bullous, with rupture of the vesicles and marked weeping and crust formation. Desquamation was complete, involving the conjunctiva, auditory canals, and ear drums. Vesicles about the anus became infected. Eosinophilia was present in all blood counts. Urine showed evidence of acute kidney condition. He received sodium thiosulphate in large doses (5 grams in 24 hours). Adjuvant treatment was confined to starch baths, emollient ointments and protection of eyes. Cure complete in two weeks.

Three additional cases offered by Dr. C. N. Larson, medical superintendent of Queen's Hospital, Honolulu, Hawaii, are added. These cases are not quoted in detail, but several interesting points are noted: They all followed the initial administration of sulpharsphenamine intramuscularly, they were all serious from the beginning, they responded to sodium thiosulphate in large doses (2 or more grams in 24 hours), they all had an eosinophilia, and all made complete recoveries.

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## THE INTERNATIONAL CLASSIFICATION OF BLOOD GROUPS[1]

By JOHN HARPER, Lieutenant Commander, Medical Corps, United States Navy

The Medical Department of the United States Navy has adopted the International Classification of blood groups. This means that this classification will replace the previously used Jansky Classification as the official method of reporting blood groups in this service.

A brief résumé of the history of blood grouping will show why the adoption of the International Classification is desirable.

In 1901, Landsteiner, an Austrian, discovered the existence of three human blood groups. He classified these groups by the letters A, B, C. Subsequently several workers found exceptions to these original three groups. In other words these workers occasionally came across a blood that apparently did not fit into Landsteiner's A, B, C groups.

However, it was left to Jansky, a Czechoslovakian, in 1907, to first incorporate these exceptions into a fourth group. His classification of the four groups was numerical, namely: I, II, III, IV. This work was published in the Bohemian language, and apparently failed to arouse interest owing to the obscurity and inaccessibility of the publication.

Therefore, in 1910, when Moss, an American, reported findings similar to Jansky's, it was not unnatural that his classification took

[1] Presented to the faculty of the United States Naval Medical School, Mar. 2, 1928. This classification has been variously called the Landsteiner, Modified Landsteiner, National Research Council Classification, etc.

precedence over Jansky's in at least the English-speaking countries. There is no question but that Moss worked independently and without knowledge of Jansky's findings. Moss likewise used a numerical clasification, but perhaps unfortunately, his groups I and IV were just the reverse of those of Jansky's. The result has been that in communities where the two classifications are used there is considerable confusion and at times actual danger.

In order to avoid this confusion and danger, the American Association of Immunologists, the American Medical Association, the Society of American Bacteriologists, and the Association of Pathologists and Bacteriologists, the Medical Department of the United States Navy, and others, in 1921, adopted, on the basis of priority, Jansky's Classification. That this classification has priority over Moss's has never been questioned. In fact, appended to Moss's article is a statement by Moss to the effect that since his paper went to press Jansky's work was brought to his notice, and that had he known about it in time he would have given Jansky credit for priority in establishing the correct classification.

Unfortunately many organizations and individuals in this and other countries did not give preference to Jansky's Classification. Therefore, the confusion and danger still exists.

Last year, 1927, in an attempt to break what might be called "the Moss-Jansky deadlock," the American Association of Immunologists adopted what logically should be called the International Classification. The idea originated with the discoverer of the groups—Landsteiner, and has the approval of the National Research Council and the medical authorities of many European countries.

The International Classification uses the letters O, A, B, AB, which designate directly von Dungren and Hirschfeld's hypothetical agglutinogen content of the red cells.

According to von Dungren and Hirschfeld's hypothetical explanation, there is distributed among the red blood cells of the groups two agglutinogens designated "A" and "B." Neither agglutinogen is present in group "O." ("O" really means "zero.") Agglutinogen "A" is present in group "A." Agglutinogen "B" is present in group "B." Both agglutinogen "A" and agglutinogen "B" are present in group "AB."

The following table shows the compatibility of the red blood cells with the sera of the various groups. As this service is primarily interested in a comparison of the International Classification with the Jansky Classification, the Moss Classification will not be compared.

*International classification*

[Numerals indicate Jansky classification. (−) indicates no agglutination. (+) indicates agglutination.]

| Cells of groups | Serum of groups | | | |
|---|---|---|---|---|
| | O (I) | A (II) | B (III) | AB (IV) |
| O (I) | − | − | − | − |
| A (II) | + | − | + | − |
| B (III) | + | + | − | − |
| AB (IV) | + | + | + | − |

DONOR (CELLS)

Group O (I Jansky): Red blood cells contain no agglutinogens and are therefore not agglutinated by sera of any group. Members of this group are known as "universal donors."

Group A (II Jansky): Red blood cells contain agglutinogen A and are not agglutinated by sera of Groups A (II) or AB (IV). In other words no agglutination with sera of groups showing the letter A.

Group B (III Jansky): Red blood cells contain agglutinogen B and are not agglutinated by sera of Groups B (III) or AB (IV). In other words no agglutination with sera of groups showing the letter B.

Group AB (IV Jansky): Red blood cell contain agglutinogens A and B in combination and are not agglutinated by the serum of Group AB (IV). In other words no agglutination with the one group showing letters AB in combination.

RECIPIENT (SERUM)

Group O (I Jansky): Serum will not agglutinate cells of Group O (I).

Group A (II Jansky): Serum will not agglutinate cells of Group A (II) or Group O (I).

Group B (III Jansky): Serum will not agglutinate cells of Group B (III) or Group O (I).

Group AB (IV Jansky): Serum will not agglutinate cells of any group. Members of this group are known as universal recipients.

RÉSUMÉ

Group O donor can give blood to a recipient of Groups O, A, B, or AB.
Group A donor can give blood to a recipient of Groups A or AB.
Group B donor can give blood to a recipient of Groups B or AB.
Group AB donor can give blood to a recipient of Group AB.
Group O recipient can receive blood from donor of Group O.
Group A recipient can receive blood from Groups O or A.
Group B recipient can receive blood from donor of Groups O or B.
Group AB recipient can receive blood from donor Groups O, A, B, or AB.

From the foregoing it will be readily seen that the international classification differs from the Jansky classification merely in the substitution of the letters O, A, B, AB for the numbers I, II, III, IV, respectively. It will likewise be noted that it is only necessary to have on hand Group A and Group B sera in order to determine the

group to which the blood of any individual belongs. Therefore, in the future requests to the United States Naval Medical School will be for sera A and B instead of sera II and III, as heretofore.

In typing bloods it is important to remember that there are atypical groups. Therefore, in addition to grouping donor and recipient, direct matching of the cells and sera of the donor and recipient should be made a routine procedure.

In conclusion it may be said that the adoption of the International Classification offers a permanent and uniform terminology in the reporting of blood groups.

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Author's note.—Since this paper was submitted for publication the Medical Department of the United States Army has adopted this classification. War Department, office of the Surgeon General, Circular letter No. 7, March 5, 1928.

# CLINICAL NOTES

## EXPERIENCES WITH THE BLOOD SEDIMENTATION TESTS[1]

By E. G. HAKANSSON, Lieutenant Commander, Medical Corps, United States Navy

In the medical wards of naval hospitals there is usually a group of patients with chronic bronchitis suspected of being tuberculous. Although the usual physical, laboratory, and X-ray examinations fail to reveal positive evidence of tuberculosis, one frequently feels that it is a possibility. The disposition of these men presents a difficult problem. The suspicion keeps one from returning them to duty but does not warrant a change of diagnosis to tuberculosis and a physical disability discharge. Similarly, in the sick officers' quarters there frequently are patients hospitalized on the recommendation of various medical boards for the purpose of investigating suspicious lung conditions. Promotion or retirement is often the issue involved and a correct diagnosis is of the utmost importance. The difficulty in establishing the diagnosis in these cases started the use of the blood sedimentation test at this hospital about a year ago.

It was soon found that to evaluate correctly the significance of the sedimentation rate, first-hand observation of the phenomenon in normals and in various diseased conditions would be necessary. A series of tests on cases appearing to be of interest in this respect was therefore begun. At this time a total of 247 tests have been performed on 126 patients. The observations made seem to be of sufficient interest to warrant a preliminary report.

NATURE OF THE TEST.—The blood sedimentation test is a laboratory application of the accelerated settling of the erythrocytes during infections and various other disturbances of the cellular activities of the body. Many theories have been advanced to explain in terms of physiology and chemistry this interesting symptom but none have been generally accepted. The assumption that the sedimentation test is an index of cellular destruction incident to infectious and other pathological activity is practical and helpful.

TECHNIQUE.—The literature on the blood sedimentation test indicates a lack of standard technique. Most of the investigators have either worked out their own method or modified the methods of earlier writers. In our work the "graphic method," originated by

[1] From the U. S. Naval Hospital, Puget Sound, Wash.

Cutler, has been used. For the convenience of the readers who may not have Doctor Cutler's article available for reference the technique will be described.[2]

The sedimentation tube designed by Cutler is the only special apparatus used. It is shown in Figure 1. The Arthur H. Thomas Co., Philadelphia, Pa., has these tubes in stock. The only other apparatus needed is a 5 c. c. syringe with needle for venipuncture. A 3 per cent solution of sodium citrate freshly prepared completes the equipment. The tube, syringe, and needle must be clean and dry to prevent clotting and hemolysis. With 0.5 c. c. of the citrate solution in the syringe, aspirate 5 c. c. of the blood and mix by slowly tilting the syringe up and down a few times. Secure the needle well, expel a few drops to clear the needle of blood which may have clotted, place the point of the needle against the glass below the zero line, to avoid bubbles and a blood-smeared tube, and expel the blood. When the column reaches the needle tip move the needle to the center of the tube to get a clear-cut margin and fill the tube until the upper meniscus levels the zero line. Note the time and read the depth in millimeters of the plasma column every five minutes for one hour. To visualize the record it is well to plot it as shown in the various accompanying graphs. The chart used is part of one designed by Cutler.

When several tests are to be made it is convenient, as Cutler points out, to collect all the specimens first and then read them simultaneously. Since, however, considerable sedimentation may have taken place in the first specimens it is necessary to tilt the tubes back and forth a few times to mix again the serum and the corpuscles before starting the reading. Cutler found that "the tubes can be allowed to stand as long as 10 hours before making any readings without losing valuable information, or noticing any practical change in the character of the graph." We found, as undoubtedly Cutler had observed, a slight difference in the first and the subsequent readings, usually an acceleration of the sedimentation during the first 5 or 10 minutes. Although the variations in the graphs and the index were insignificant for practical purposes, as also Cutler states, we desired in our work to eliminate all possible variations in the technic, and to that end the reading was begun at the moment the tube was filled. When several tests were to be done they were timed five minutes apart for convenience in the subsequent readings.

General remarks.—All our cases were of the male sex. With a few exceptions they were young adults between the ages of 18 and 30 years. The tests were made without any particular preparation of

[2] Cutler has more recently described a new technique in which a small amount of blood obtained by finger puncture is used. Cutler, J.: A finger-puncture method for the blood sedimentation test, Am. J. Med. Sci., 1927, 173, 687.

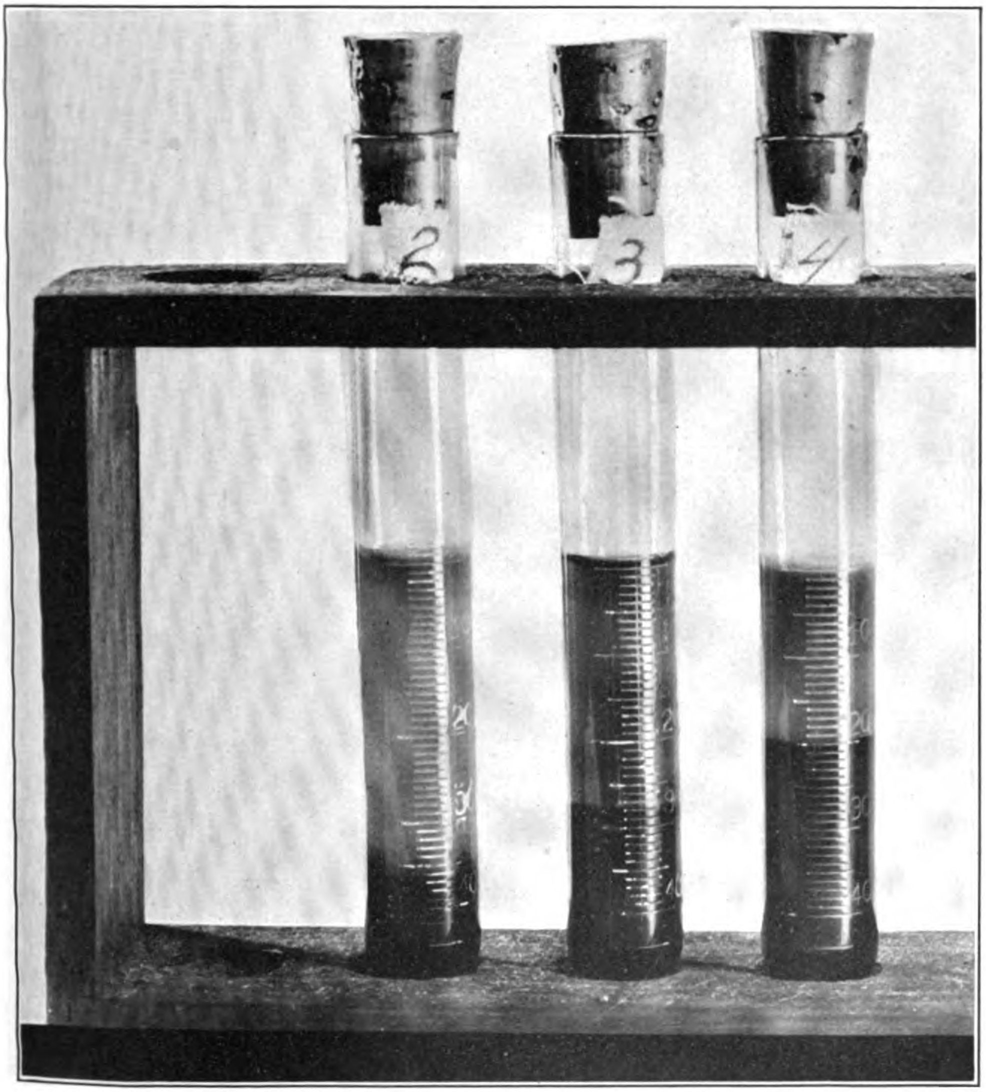


Fig. 1.—The Cutler sedimentation tube. The lines are 1 mm. apart and mark tenths of a cubic centimeter

the patient. All tests were made between 10 a. m. and 11 a. m. The sedimentation was observed only for one hour, and the discussion to follow deals only with the one-hour sedimentation.

For convenience in the discussion of the sedimentation records the terms sedimentation index and sedimentation time, as employed by Cutler, will be used; the sedimentation time being the number of minutes required for the sedimentation process, up to the point from where further sinking of the red blood cell column merely represents the slow packing of the cells, and the sedimentation index, the total sedimentation expressed in millimeters at the end of one hour.

THE NORMAL SEDIMENTATION INDEX.—The normal sedimentation index apparently is not the same in all individuals. The upper limit found so far is 2. The lower limit is probably 4, although several men in whom we were unable to find any signs of infection or other pathology gave an index of 5. Until further evidence becomes available it is probably well to consider as normal an index from 2 to 5.[3] Cutler is more liberal in the allowance for variations: "The sedimentation index for men varies from 2 to 8 mm., with an average of 3 to 4." The estimate of the lower limit as 5 mm. was made after observing that patients with a sedimentation index of more than 5 always presented clinical findings of some infection and that all cases of acute and chronic infections followed to complete convalescence ultimately showed a sedimentation index of 5 or less.

A composite graph of normal sedimentations is shown in Figure 2. The heavy line indicates the average normal. The shaded areas represent the variations accepted as within the range of normalcy. This graph was obtained from tests on 10 men clinically free of disease and apparently in excellent health and from tests on 17 patients who, for the purpose of the sedimentation reaction, were considered normal. In these patients the clinical history, the subjective symptoms, and the objective findings of the physical examination and laboratory tests revealed no evidence of any acute or chronic infection or neoplasm. They were afflicted with the following disabilities: Cardiac disorder, functional, 2; constitutional psychopathic state, 1; dementia precox, early stage, 2; duodenal ulcer, convalescence, 4; epilepsy, 1; gastroenteritis from dietary indiscretion, convalescing, 1; goiter, simple, 1; neurasthenia, 5.

THE NONSPECIFICNESS OF THE BLOOD SEDIMENTATION TEST.—Before discussing the sedimentation in pulmonary tuberculosis and other diseases it may be well to emphasize the nonspecificity of the blood sedimentation test. It does not seem to show any definite characteristic for tuberculosis or any other infection. The rapid sedimenta-

[3] Since this was written Greisheimer has reported the average index for 13 normal men as 2.1 mm. Greisheimer, E. M.: The blood sedimentation test in normal men and women. Am. J. Med. Sci., 1927, 174, 338.

tion of an active pulmonary tuberculosis may also be seen in an acute bronchitis or pneumonia and in infections of other organs. In Figure 3 are shown the graphs of four almost identical sedimentations in widely different cases—namely, active advanced pulmonary tuberculosis, syphilis with secondary pustular syphilids, lobar pneumonia, and pelvic abscess. On the other hand the sedimentation rate is remarkably indifferent to pathology of noninfectious nature. Striking evidence of this fact was observed in many instances. One

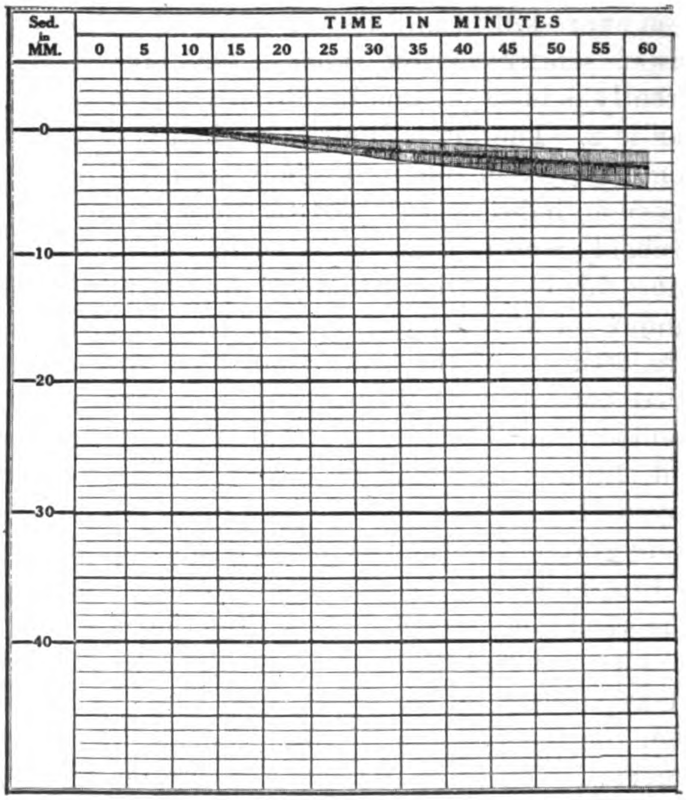


FIG. 2.—Normal sedimentation. The heavy line indicates the typical normal graph. Variations considered normal fall within the shaded zone

case particularly elucidated this point and seems to warrant a description.

*Case 104.*—White, age 56 years. The first test was done on April 29, 1927, and showed an index of 1.5 mm. (graph E, fig. 3), the slowest sedimentation seen in any case and 0.5 mm. less than in any observed normal. At this time he was in the throes of an acute cardiac decomposition with a pulse rate of 180, cyanosis and air hunger. The blood plasma had a bilirubin index of 15 and this latent jaundice and a history of chronic alcoholism suggested hepatic cirrhosis. Urine analysis indicated a chronic nephritis. During a previous hospitalization it had also been shown that he had Hirsch-

sprung's disease. On May 3, three days after the sedimentation test, he developed a pulmonary embolism and infarct with hemoptysis and signs of consolidation in the right lower lobe. Two days later, on May 5, the sedimentation rate showed only the slightest observable increase (graph F, fig. 3). He died 24 hours later. Autopsy confirmed the clinical diagnosis. The major pathological findings were dilation of the right auricle and ventricle, atheroma and dilation of the arch of the aorta, hemorrhagic infarct of almost the whole right

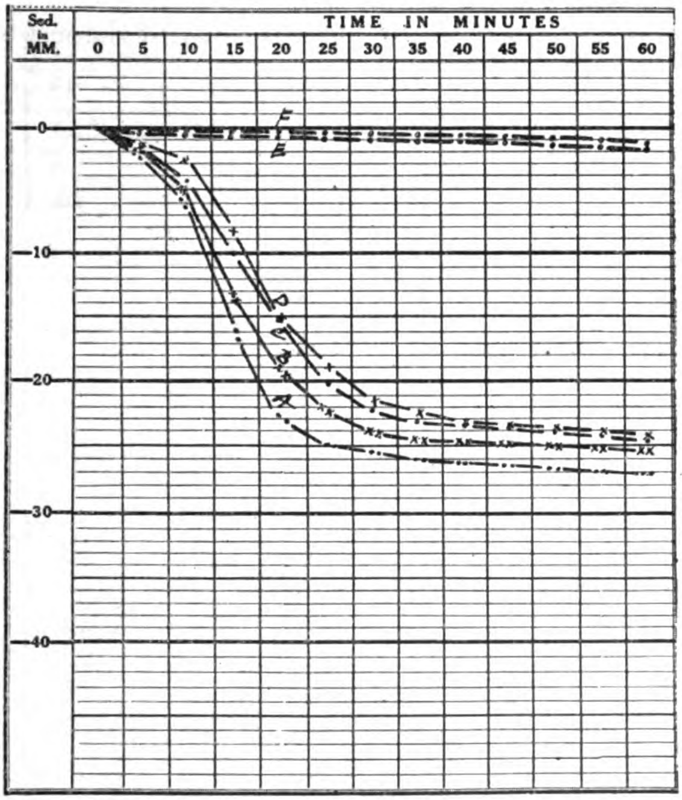


Fig. 3.—Nonspecificness of the blood sedimentation test; almost identical in four widely different diseases. A, pelvic abscess; B, lobar pneumonia; C, syphilis; D, tuberculosis, pulmonary, active, advanced. E and F show indifference of test to pathological conditions of noninfectious nature. The subject suffered with acute cardiac decompensation, chronic nephritis, and other conditions

lower lobe of the lung, passive congestion of the left lower lobe, advanced atrophic cirrhosis of the liver, chronic interstitial nephritis, and an enormous dilation and hypertrophy of the descending colon. Particularly significant in this case is the acute extensive pathology of the infarct having practically no influence on the sedimentation rate. This phenomenom apparently would furnish a very accurate differentation between the consolidation of an infarct, not infected, and the consolidations of pneumonia or abscess.

**Sedimentation rate most rapid in conditions where excessive blood destruction occurs.**—The causative relation of cellular destruction to the sedimentation rate was seen in a case of acute lymphatic leukemia and one of arsine, $AsH_3$, poisoning with severe hemoglobinemia. The spectacular descent of the erythrocytes in these cases is shown in Figure 4. The case of acute leukemia (Graph A) was a male, white, age 57. He had been ill four and a half months, running an irregular septic fever up to 104° and 105° F.; the red blood cells had decreased from normal to 1,550,000 and the hemoglobin to 48 per cent. The white blood cell count on the day of the test was 53,000,

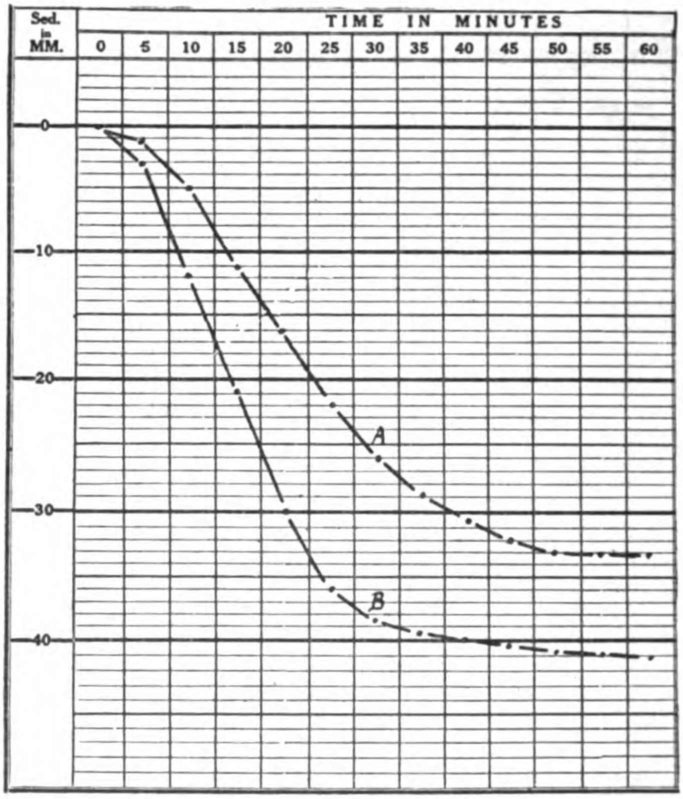


Fig. 4.—Rapid sedimentation rate in conditions with massive destruction of erythrocytes. A, acute leukemia; B, acute arsine poisoning with severe hemoglobinemia

with 79 per cent lymphocytes. He died two weeks later. The necropsy confirmed the diagnosis. The case of poisoning was a laborer in a galvanizing shack exposed to fumes containing arsine. Onset nine days before the test with vomiting and bloody urine, which 12 hours later turned to the sherry color of hemoglobinuria. At the same time the skin became deep brown. A day later complete anuria set in. On the day of the test he was in severe uremia. A blood count showed red blood cells 1,030,000, hemoglobin 43 per cent, white blood cells 7,500. He had no fever. The skin was still bronzed and the blood serum light brown. He died two days later in uremia.

The necropsy confirmed the diagnosis. The rate of sedimentation in both cases is remarkably rapid, in the first case 26 mm. and in the second case 38.5 mm. during the first 30 minutes. Due to the small corpuscle volume allowing a greater distance of descent, the sedimentation time, 35 and 45 minutes, respectively, is not shorter than in many other cases discussed below.

BLOOD SEDIMENTATION IN VARIOUS ACUTE INFECTIONS.—Lobar pneumonia offers an especially favorable condition for the study of the blood sedimentation. It is a severe infection, well defined in onset

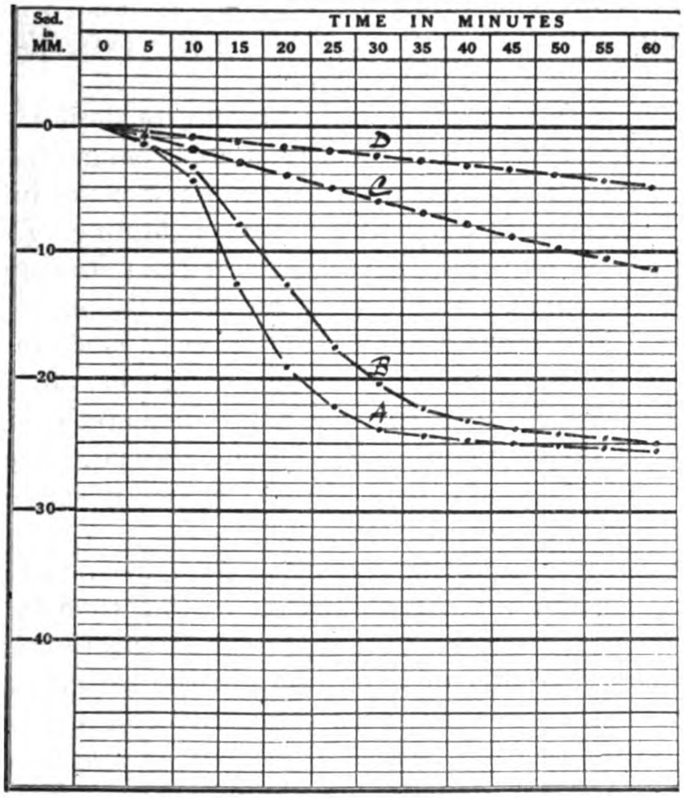


FIG. 5.—Sedimentation in lobar pneumonia. A, January 9, 1927: Onset 5 days ago; consolidation of right lower lobe; T., 104.6°; W. B. C., 18,000. B, January 12, 1927: Crisis began 12 hours ago; T., 99.2°; W. B. C., 9,000. C, January 17, 1927: T., normal for 2 days; lungs clear. D, February 12, 1927: Recovered

and termination, and readily followed in its various stages. The graphs of four sedimentation tests taken on a case of typical lobar pneumonia terminating by crisis and convalescing without complications are shown in Figure 5. Graph A, from a test done on January 9, 1927, five days after the onset, shows the typical rapid sedimentation of a severe acute infection. The sedimentation is complete in 30 minutes and only a packing of cells takes place during the second half hour. Three days later, and at the very end of the crisis, the sedimentation has slowed up considerably as shown in Graph B. It

now takes 45 minutes to reach the packing stage and the curve of the graph is less acute. The change in the blood sedimentation is less striking, however, than the clinical phenomena of postcrisis well-being, normal temperature, and normal leukocyte count. On January 17, 13 days after onset and 5 days after crisis, and after the temperature has been normal for 2 days, the sedimentation is approaching normal, as shown in Graph C, and when taken after 16 days of uneventful convalescence it is just within normal limits, as Graph D illustrates. There is thus in this case of pneumonia a very close correlation between the sedimentation rate and other clinical findings usually relied upon for estimating the patient's condition and progress.

In other acute infections the sedimentation rate similarly followed other clinical signs of favorable or unfavorable changes. In Figures 6 to 11, inclusive, the sedimentation test in a few acute infections is shown in the graphs and the essential clinical findings given in the legends. It may be observed that in general the sedimentation rate follows the fever curve. The higher the fever the more rapid the sedimentation. The sedimentation rate, however, is slower than the temperature in returning to normal from several days to weeks. In the case of German measles (fig. 7), the sedimentation index was 7.5, 18 days after the temperature had become normal. A persistence of the adenopathy was the only clinical evidence supporting the accuracy of the test.

The sedimentation rate in syphilis.—As a means of observing the sedimentation rate in a chronic infection other than tuberculosis, the test was done in a few cases of syphilis. It was thought that in several features apparently of importance in the sedimentation rate, the two diseases were similar; both commonly run a slow, chronic course; both exhibit various stages of activity and apparently may become more or less arrested. It was found that the sedimentation rate follows closely the clinical picture of activity or latency of the infection. This can be seen in Figure 12, which contains the graphs of a test on each of eight cases in various stages of the disease. It may be of interest to give the clinical condition of these cases in more detail than is disclosed in the legends, particularly since some of them are presented later to show the effect of antisyphilitic treatment.

*Case 72* (graph A).—Exposure six weeks ago. No primary lesion noted. Secondaries appeared two weeks ago. He has now pustular syphilides on all parts of the body and marked generalized adenopathy. Fever up to 100° F. Kahn positive, plus four. Received one dose of arsphenamine, 0.4 grams, five days ago. The rapid descent of the erythrocytes, with a sedimentation time of only 30 minutes, seems to indicate a more severe pathological activity than one usually associates with syphilis, even when most acute as in this case.

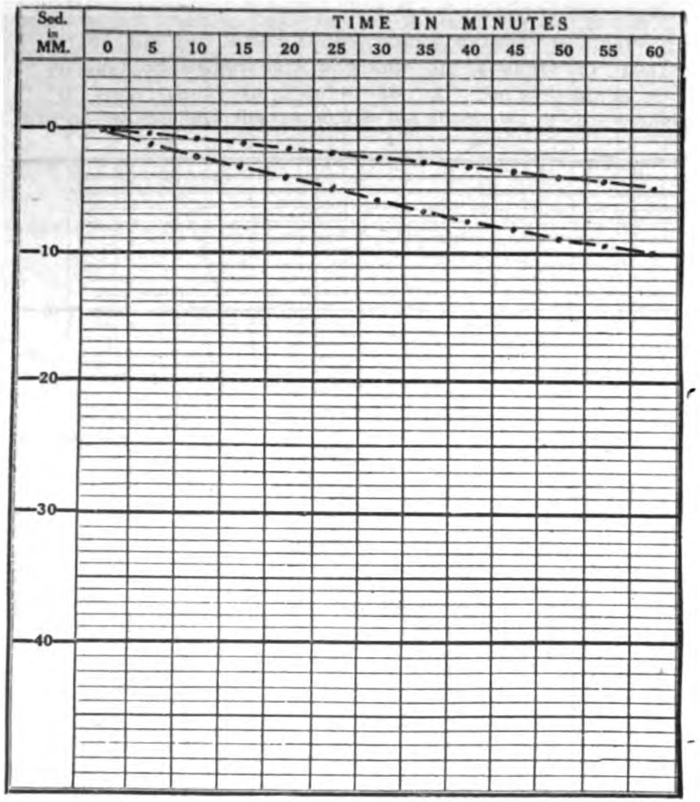


FIG. 6.—Sedimentation in acute catarrhal fever (common cold). A, January 25, 1927: Onset 24 hours ago; T., 102°. B, January 31, 1927: Convalescence complete

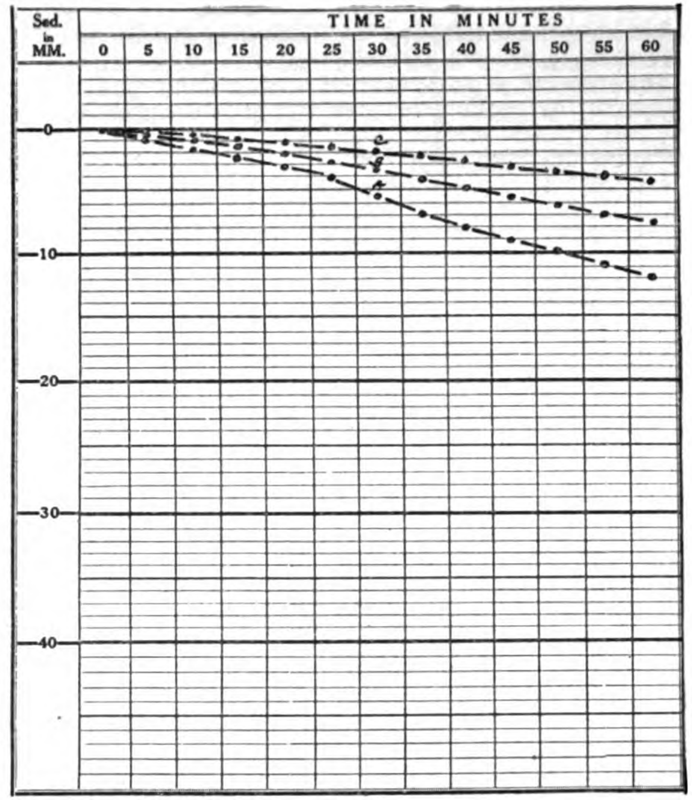


FIG. 7.—Sedimentation in German measles. A, January 27, 1927: Disease at height; T., 99.2°; W. B. C., 6,200. B, February 17, 1927: No fever for three days. C, March 24, 1927: Apparently in perfect health; glands still palpable

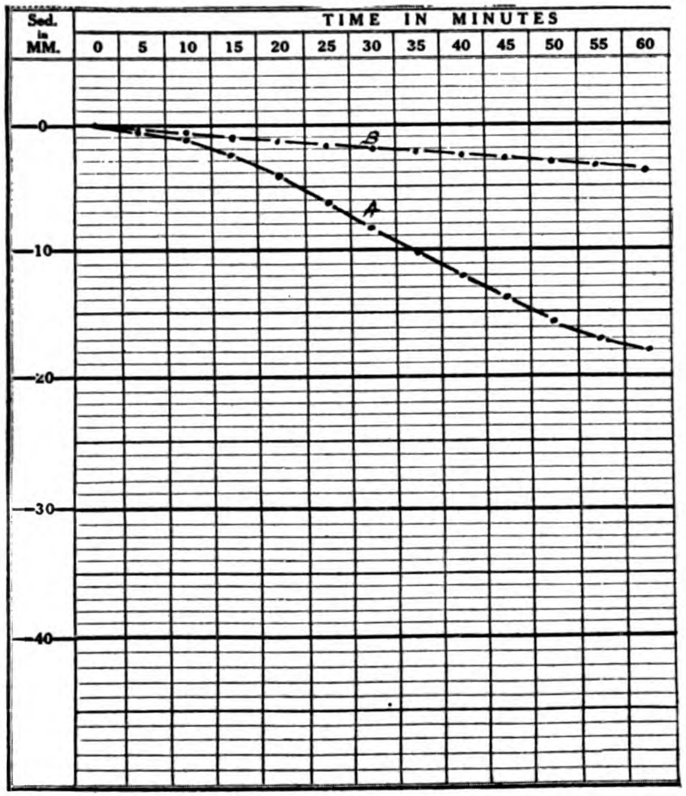


FIG. 8.—Sedimentation in acute pericarditis. A, December 28, 1926: Onset four days ago; T., 100.2°; W. B. C., 16,000; precardial pain and rub. B, January 11, 1927: T., normal for week; convalescence appears complete

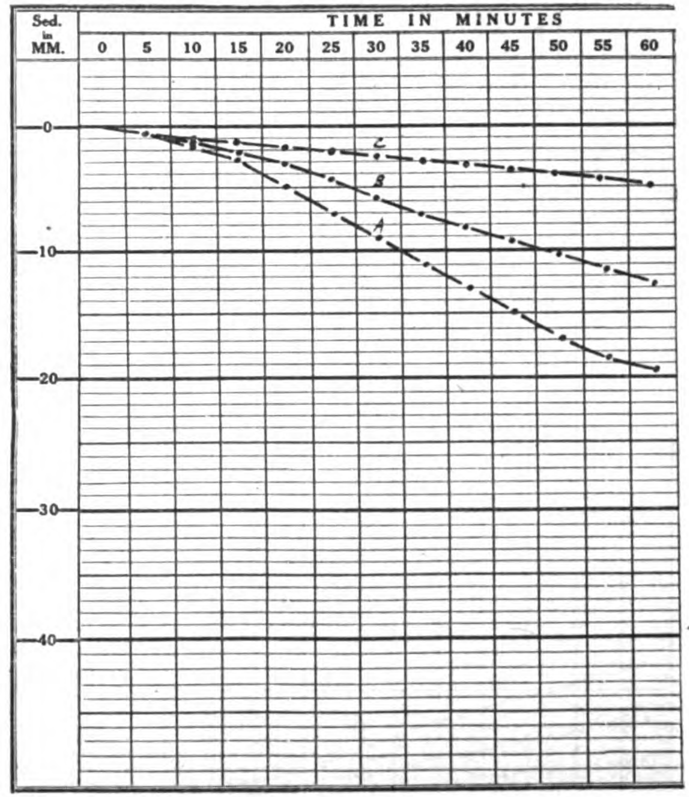


FIG. 9.—Sedimentation in chancroid of penis. A, December 30, 1926: Onset 25 days ago; chancroid of moderate size; adenitis almost at point of suppuration. B, January 12, 1927: Chancroid healed; one gland suppurated and was drained. C, February 2, 1927: No signs of adenitis for week

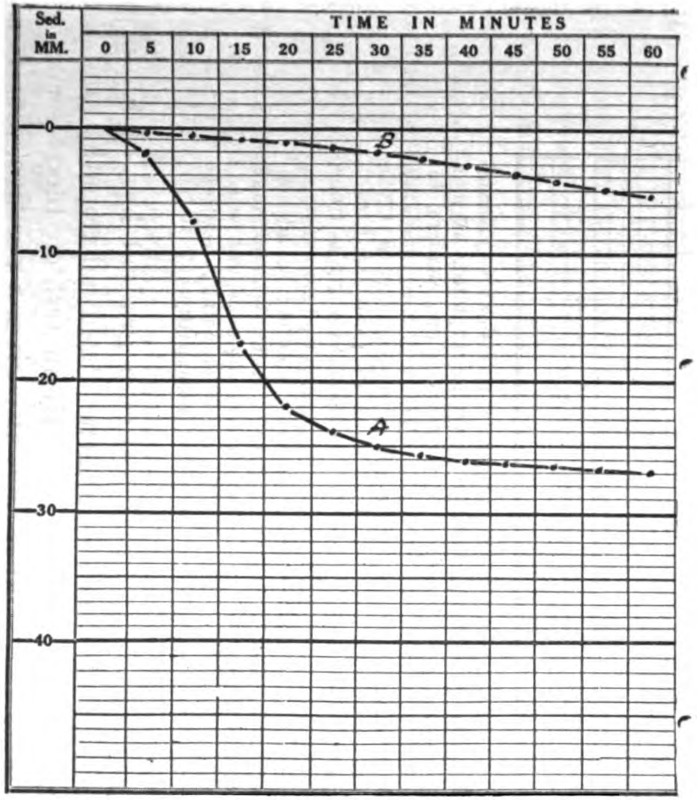


FIG. 10.—Sedimentation in gonorrheal arthritis. A, November 15, 1926: Onset of gonorrheal urethritis 1 month ago; epididymitis and arthritis 10 days later; at present, epididymitis cured, urethritis subacute, acute arthritis in one knee; T., remittent, to 101°. B, December 30, 1926: No fever for month; knee still enlarged, but no pain nor tenderness present

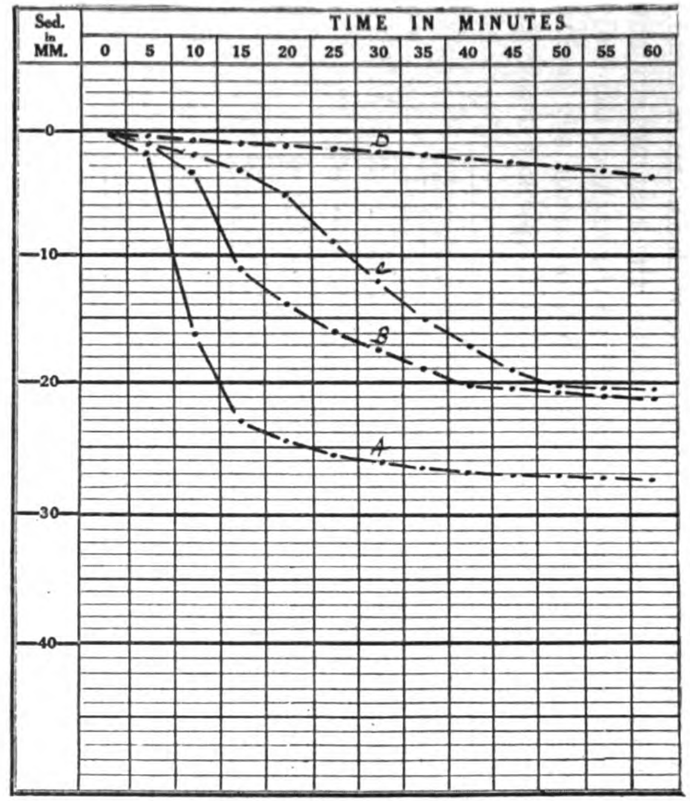


FIG. 11.—Sedimentation in rheumatic fever. A, November 4, 1926: Onset 4 days ago, concurrent with acute tonsillitis; wrists, knees, and ankles involved. B, November 11, 1926: Pain and swelling subsiding; T., normal for 24 hours. C, December 5, 1926: Temperature and joints normal. D, January 4, 1927: Recovery complete

*Case 74* (graph B).—Chancre on penis of 10 days duration. Slight inguinal adenitis. Kahn positive, four plus. He has no fever and has received no treatment. The diagonal line, with an index of 23.5, indicates a considerable activity and confirms the assumption that even at this early stage the infection has spread throughout the body.

*Case 97* (graph C).—No history of primary or secondary lesions can be obtained. He has had a headache and frequently fever for

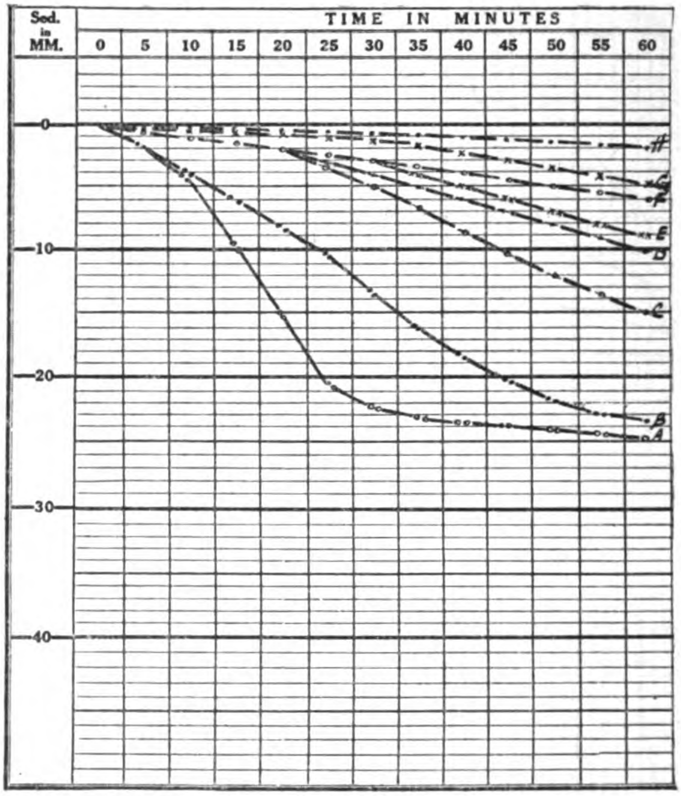


FIG. 12.—Sedimentation in syphilitic infections. A, secondary stage with generalized pustular syphilid, adenopathy, and fever to 100°. B, primary stage, chancre, inguinal adenitis; no fever. C, syphilis of long standing, untreated, apparently generalized, but chiefly in CNS; Kahn test on blood and spinal fluid, 4+; cell count, 540; globulin positive; generalized adenopathy; T., to 100°. D, early primary, small chancre, inguinal adenopathy; no fever. E, secondary, with macular syphilid; no adenopathy; no fever. F, dementia paralytica in advanced stage, treated intensively; no fever. G, tabes dorsalis, untreated; no fever. H, syphilis of five years' standing; headache and stomach trouble; generalized adenopathy

more than a year, and during this time a gradual loss of his previously good health. There is a generalized adenopathy and he runs an afternoon fever of 100° F. Kahn test on blood serum is positive, plus four. The spinal fluid also gives a positive, plus four, Kahn. It has a cell count of 540, is positive for globulin, and gives a curve in the Lange test of 0000223310. Knee jerks are exaggerated.

The mental condition is normal except marked impairment of memory for recent events. No antisyphilitic treatment received.

*Case 29* (graph D).—Chancre on penis of five days' duration. Very slight inguinal adenopathy. Darkfield positive for *Treponema pallida.* Kahn positive, plus four. No fever.

*Case 80* (graph E).—Chancre six weeks ago. He now has a macular syphilid; no adenopathy, no fever. Kahn on blood serum positive, plus four. He has received no treatment.

*Case 70* (graph F).—Dementia paralytica in advanced stage, diagnosed four years ago. Kahn positive, plus four on blood serum and spinal fluid. He has been treated intensively with arsphenamine and mercury for four years.

*Case 71* (graph G).—Tabes dorsalis, probably of at least five years' standing, discovered at an examination in connection with an application for pension on account of "stomach trouble" (gastric crises). Kahn positive, plus four on blood serum and spinal fluid, the latter also showing a cell count of 120, positive globulin test, and Lange 0112211000. No treatment received.

*Case 33* (graph H).—Syphilis of about five years' standing. Headache and stomach trouble are the only subjective symptoms. He has generalized adenopathy but no other physical findings of syphilis or other disease. His physical condition in general appears excellent. Kahn on blood serum positive, plus four. Spinal fluid entirely normal. He has received no treatment. It is of interest to note that although this patient, according to the evidence of headache, adenopathy, and plus-four Kahn, must be considered as harboring a heavy infection, the sedimentation rate is normal. It would appear that in this case the body with it own biological defense had fought the Treponema to a standstill, at least so far as the pathological activity reflected in the sedimentation rate is concerned.

In four of the above cases of syphilis the effect of treatment on the sedimentation rate was studied. The result is shown in Figures 13, 14, 15, and 16. In the recent infections, case 72 (fig. 13) and case 74 (fig. 14) the rate of sedimentation decreases as the treatment and clinical improvement progress. In case 97 (fig. 15), where the syphilitic infection was of long standing, there is first an acceleration of the sedimentation rate, apparently indicating an activation of dormant syphilitic lesion probably in the nature of a Herxheimer reaction. As more treatment is given the sedimentation rate is brought back to and slightly beyond the pretreatment rate.

Similarly in case 33 (fig. 16), also a case of long standing without treatment, the first effect of the treatment is an increase in the sedimentation rate.

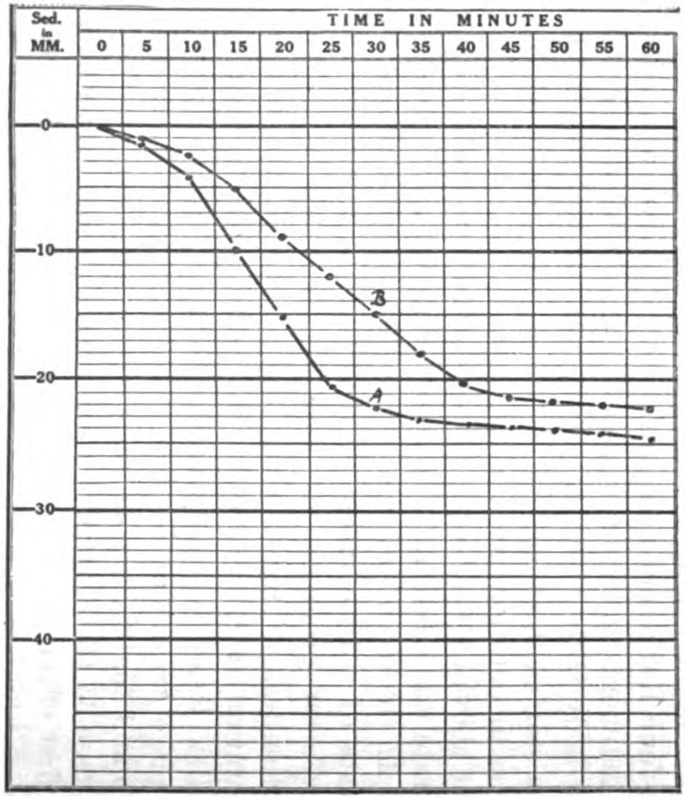


FIG. 13.—Effect of antisyphilitic treatment on sedimentation rate; patient in secondary stage, with generalized pustular syphilid. A, December 20, 1926: No treatment received. B, January 11, 1927: Has had three injections of arsphenamine and three of mercury salicylate

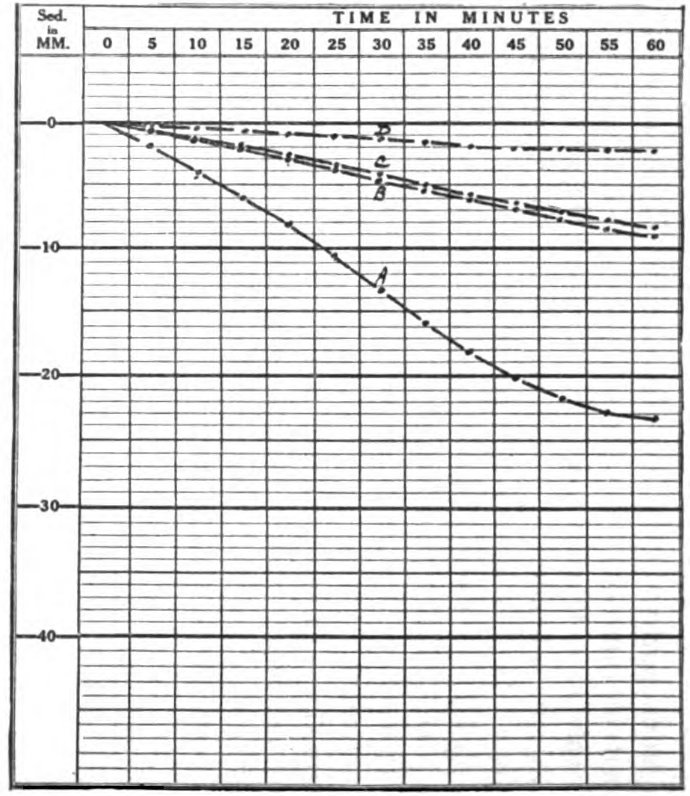


FIG. 14.—Effect of antisyphilitic treatment on sedimentation rate; primary stage, with chancre on penis and inguinal adenitis; Kahn, 4+. A, December 30, 1926: No treatment. B, January 12, 1927: Has received three intravenous injections of arsphenamine and three of mercury. C, January 25, 1927: One more injection of arsphenamine and one of mercury. D, April 26, 1927: Further treatment, two of arsphenamine and five of mercury; Kahn, 4+

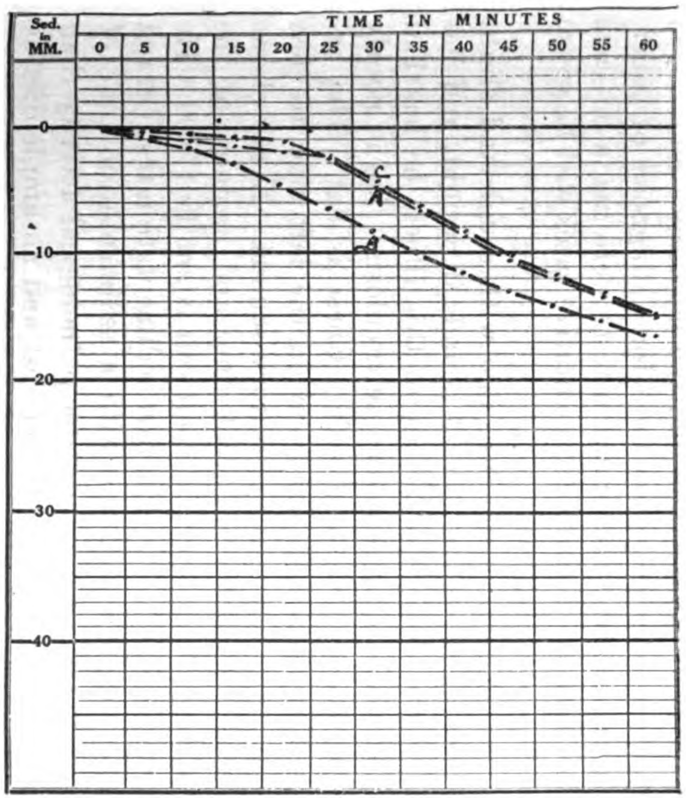


FIG. 15.—Effect of antisyphilitic treatment on sedimentation rate; syphilis of long standing, mainly manifest in CNS. A, March 5, 1927: No treatment. B, March 24, 1927: Three injections of arsphenamine, three of mercury salicylate, KI; acceleration of sedimentation rate probably indicates an activation of dormant lesions. C, April 26, 1927: Three additional injections of arsphenamine, weekly injections of mercury, and KI

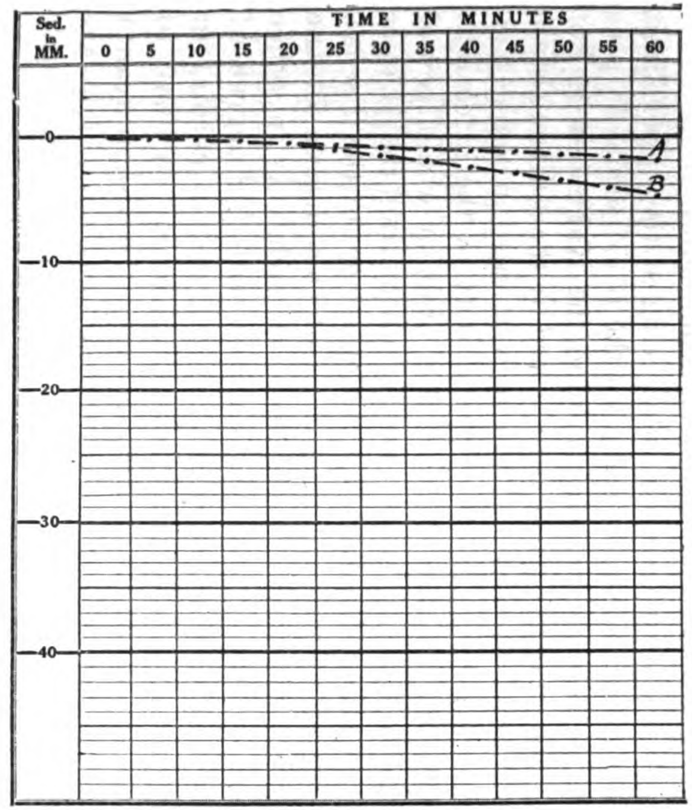


FIG. 16.—Effect of antisyphilitic treatment on sedimentation rate; syphilis of five years' standing. A, March 17, 1927: No treatment. B, April 26, 1927: Three injections of arsphenamine and four of mercury; increased rate indicates activation of the old syphilitic infection

It is notable that, as seen in case 74 (fig. 14), the sedimentation rate returns to normal although the Kahn test remains positive.

*Case 33* (fig. 16) presents the same condition before administration of treatment; the sedimentation index being at the upper limit of the observed normal, while the Kahn on the blood serum is plus four. Apparently the condition determining the Kahn test is not a factor in the stability of the blood as indicated by the sedimentation test. A combination of the two tests may be warranted in some cases in order to obtain a clearer picture of the activity of the infection; and it is possible that further study of this problem would reveal the sedimentation test as of some value in estimating the proper extent of antisyphilitic treatment in the various stages of the disease.

Acute bronchitis.—There are nine cases of this disease in the series. From two to four tests were made on each. As in other acute infections, the sedimentation rate varied with the degree of fever and other symptoms of infection. It returned to normal in all cases. The number of tests made on each case was too small to establish the time of return to normal relative to the disappearance of the fever, the leucocytosis, or the other symptoms, but it appears quite certain that the abnormality in the sedimentation rate is the last to disappear, with the occasional exception of a slight dry cough. The graphs of three cases are shown in Figures 17, 18, and 19.

Chronic bronchitis.—The series includes 14 cases of chronic bronchitis. With two exceptions all were suspected of pulmonary tuberculosis, but the physical examination and the laboratory and X-ray findings did not furnish sufficient evidence for a diagnosis of tuberculosis. From three to five sedimentation tests were made on each case. The clinical history of three representative cases will be given to bring out the important features.

*Case 19* (fig. 20).—Onset two months ago with cough and slight fever. He has poor appetite, has lost 15 pounds in weight, and has had a few mild night sweats. Previous to this illness he has had frequent colds. Father has pulmonary tuberculosis. He is poorly nourished, weight 107 pounds, and pale. Chest is flat. The expansion and the diaphragmatic excursion on the left side are less than on the right. No abnormal respiratory sounds. X ray shows more than the usual peribronchial thickening and haziness of the left costophrenic angle. The white blood cell count is 17,000. He has an afternoon fever of 99° F. The first sedimentation test (graph A) shows an unexpected rapid rate with a sedimentation time of only 35 minutes, indicating a much greater pathological activity than evidenced by the clinical picture. Under rest and an ample diet he improved. There was only an occasional rise of afternoon temperature to 99° F. He gained 4 pounds a week in weight. Daily sputum

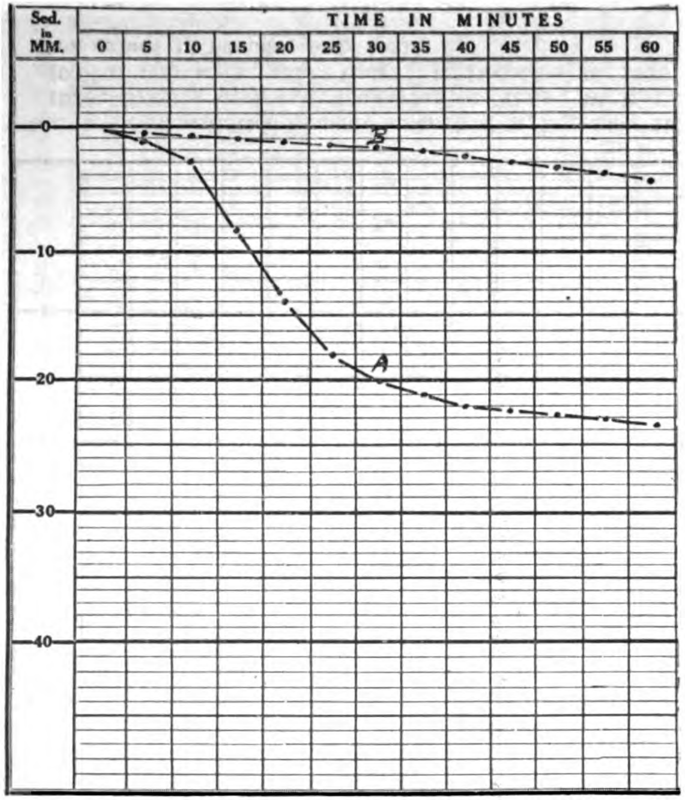


FIG. 17.—Sedimentation in acute bronchitis. A, September 12, 1926: Onset 10 days ago; T., remittent, to 101°–102°; during last 3 days only to 100°; W. B. C., 12,700; productive cough, moist râles in both lungs. B, November 21, 1926: No fever since September 16; cough gone; has gained 20 pounds in weight

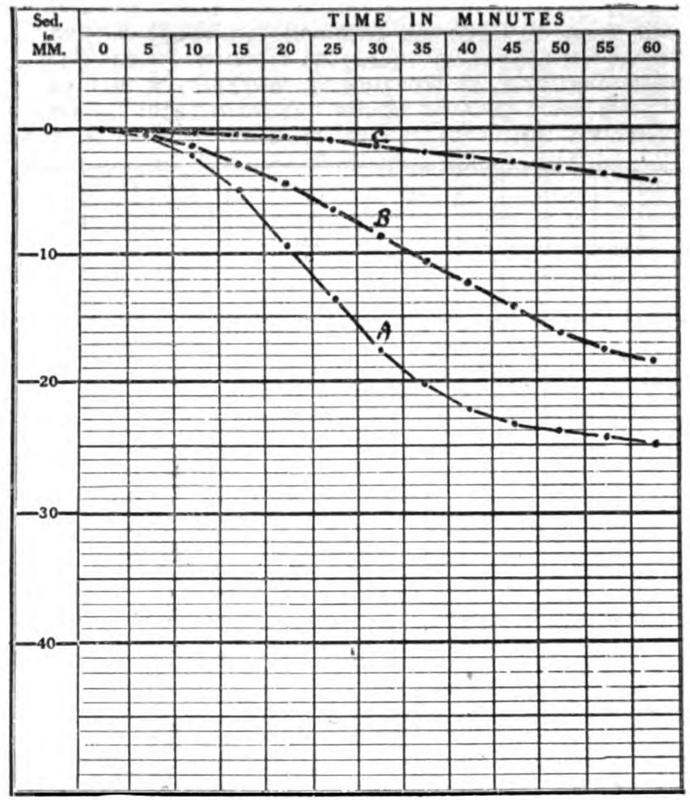


FIG. 18.—Sedimentation in acute bronchitis. A, December 7, 1926: Onset six days ago; T., 102° yesterday, 99° today; W. B. C., 9,000; moist râles, productive cough. B, December 16, 1926: T., normal since last test, except for one rise to 99°; slight cough. C, January 5, 1927: Recovery complete

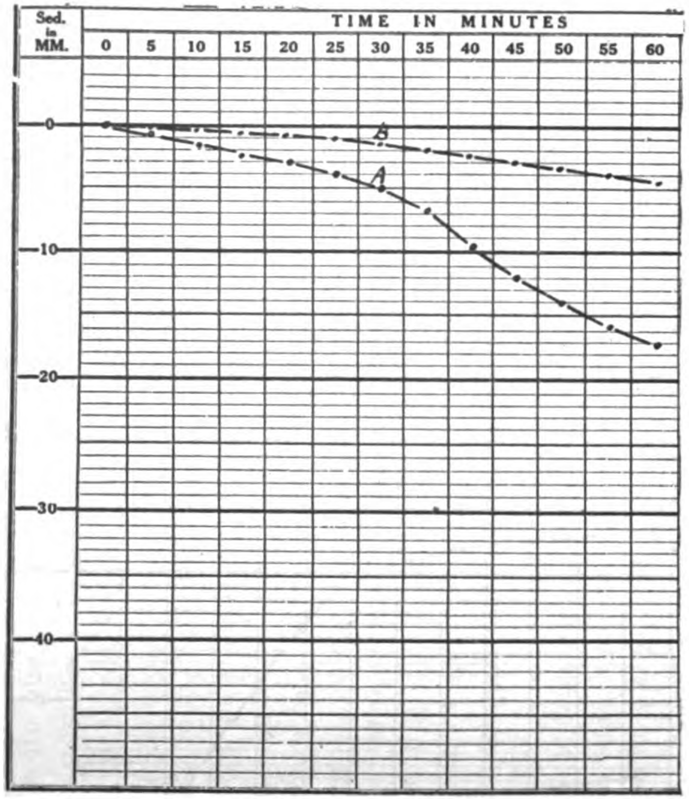


FIG. 19.—Sedimentation in acute bronchitis. A, December 13, 1926: Onset a week ago; improving; no fever; W. B. C., 10,000; very weak; slight cough. B, December 30, 1926: has gained 14 pounds; feels well

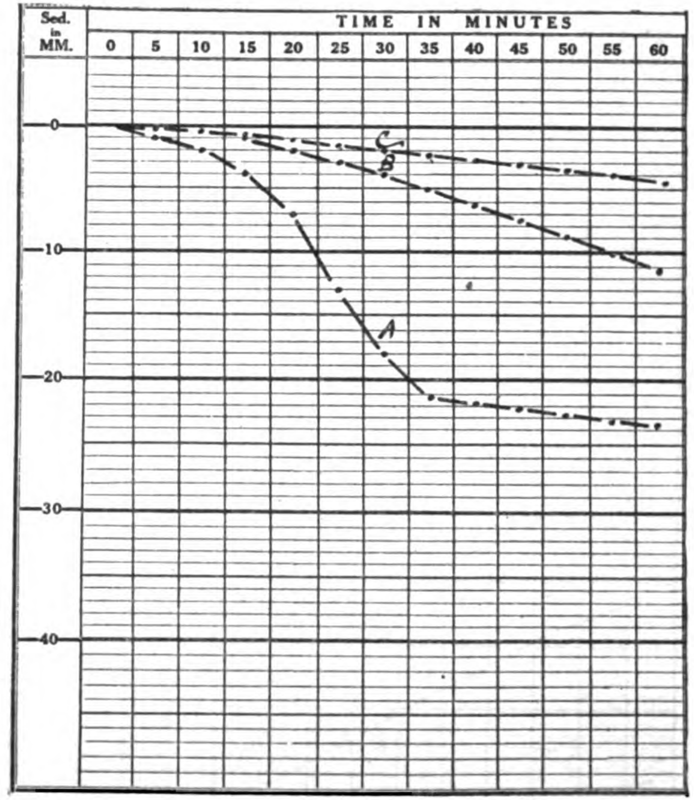


FIG. 20.—Sedimentation in chronic bronchitis. A, October 18, 1926: Onset two months ago; afternoon fever of 99°; W. B. C., 17,000. B, November 11, 1926: Occasional rise of temperature to 99°; W. B. C., 12,000; less cough; gaining weight. C, November 22, 1926: No fever since last test; cough has disappeared

examinations were negative for *B. tuberculosis*. The leucocyte count dropped to 12,000. The second sedimentation test, taken three weeks after the first, reflected this improvement as shown in graph B. From this time on the temperature was normal, the cough disappeared, the gain in weight and strength continued, and within a month he was considered fit for duty. The sedimentation rate had then returned to normal (see graph C).

*Case 100* (fig. 21).—During the last five months he has had frequent colds in the chest and persistent coughing. He had pneumonia in childhood. In 1924 he was ill for three months with severe cough, loss of weight, and weakness. Physical examination is essentially negative. The chest presents no findings of pulmonary pathology. He has an afternoon fever of 99° F. The pulse rate is 85; the white blood cell count, 9,900. Radiogram of chest shows a slightly exaggerated shadow of the right hilus, otherwise negative. The first sedimentation test (graph A), as in the previous case, indicates the presence of more pathological activity than one would suspect from the other clinical findings. Ten days later the sedimentation rate (graph B) shows some improvement. The graph has straightened out, increasing the sedimentation time, but the index is only 0.5 mm. less. During these 10 days there had been a corresponding clinical improvement, less cough, no fever for the last five days, slight gain in weight. This improvement continued. He remained afebrile, regained normal weight, and had no cough. The sedimentation tests taken one month and two months after the first test (graphs C and D) similarly show the disappearance of infection.

*Case 71* (fig. 22).—Cough, fever, loss of weight and strength during the last month. Physical and X-ray examinations of chest are negative. He has an afternoon fever of 99° F. and leucocytosis of 14,000. The first sedimentation test (graph A) gives a corresponding indication of infection. During the following week he improved and was given 10 days' leave. On return he had a recurrence of the bronchitis, with fever of 99° F. and a leucocytosis of 20,000. The second test (graph B) shows a slight exacerbation. The symptoms again abated and a tonsillectomy was performed. Five days later the third sedimentation test was made (graph C). The increased rate is undoubtedly an effect of the tonsillectomy. His enlistment expired 10 days later and he was discharged physically fit. Three months later he applied for reenlistment. He was in excellent physical condition. The sedimentation rate at this time (graph C) had returned to normal.

In the first two cases, case 19 and case 100, tuberculosis was suspected. The sedimentation tests did not help to remove the suspicion. On the other hand, if the graphs of these cases (fig. 20 and fig. 21) are compared with the graphs of the last case (fig. 22),

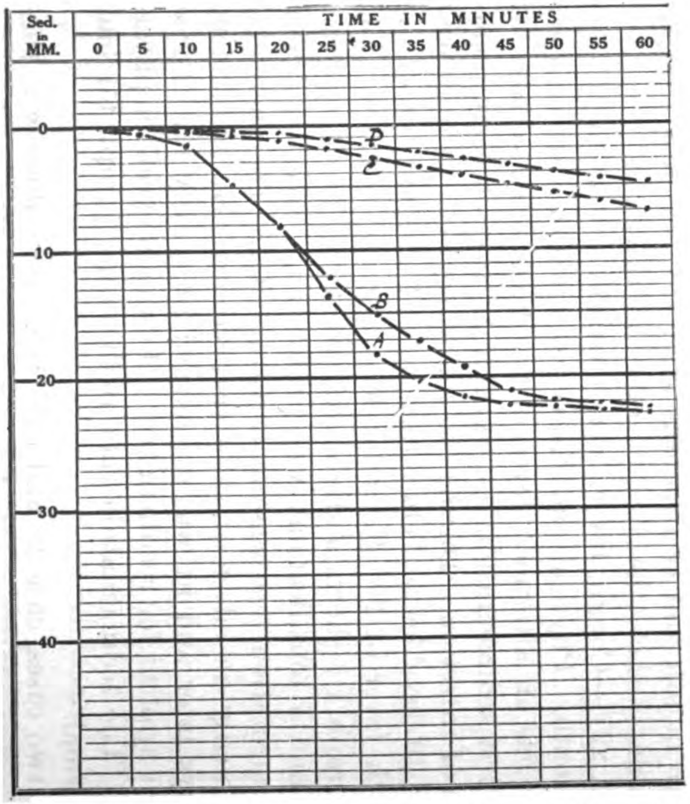


FIG. 21.—Sedimentation in chronic bronchitis. A, March 14, 1927: Frequent colds and coughing for five months; afternoon temperature, 99°; W. B. C., 9,900. B, March 24, 1927: Less cough; no fever for five days. C, April 13, 1927: Further clinical improvement. D, May 18, 1927: Recovery complete

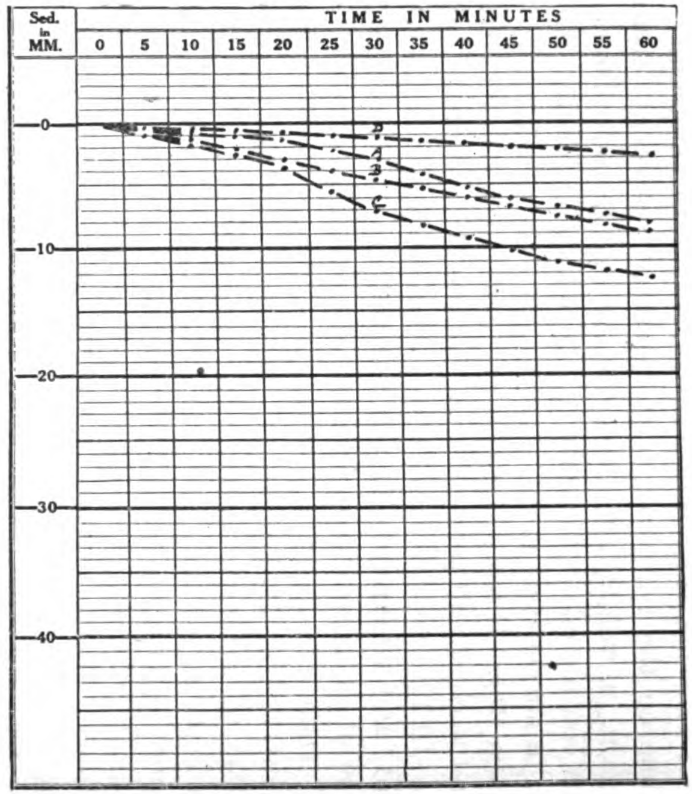


FIG. 22.—Sedimentation in chronic bronchitis. A, December 16, 1926: Cough, fever, loss of weight for month; afternoon fever of 99°; W. B. C., 14,000. B, January 4, 1927: Exacerbation after 10 days' leave; W. B. C., 20,000. C, January 15, 1927: Bronchitis cured; tonsillectomy 5 days ago. D, April 29, 1927: In excellent physical condition

which presented no history or clinical signs indicative of tuberculosis, it appears that the sedimentation tests support the suspicion. The first test in both cases reflects an activity far greater than manifested in the other clinical findings, and the last test in each of the two cases barely reaches the lower limit of what has been accepted as normal. It would seem that an early pulmonary tuberculosis coming to a quick arrest would give just such a sedimentation picture.

PLEURISY, FIBRINOUS AND SEROFIBRINOUS.—To further clear the field for the discussion of pulmonary tuberculosis, the behavior of the sedimentation in a few cases of pleurisy will be shown. Aside from the suspicion of tuberculous origin generally held in cases of pleurisy without any determinable etiology, these cases presented no evidence in the medical history, physical, X-ray, and laboratory findings of pulmonary tuberculosis. Tests were made on nine cases of pleurisy. Only two of these were hospitalized sufficiently long for a study of the whole course of the disease. The history of these will be given below. In the other seven cases one or two tests were made. The graphs obtained verified the clinical estimate of the activity of the disease and in general supported the findings in the two complete cases.

*Case 53* (fig. 23).—Onset three days ago with sharp cutting pains under the left costal border. He has had a cold in the chest for about a week but prior to this his health has been excellent. There is a pleuritic friction rub over the left lower lobe. He has a fever of 99.2° F., yesterday 102° F., and a leucocytosis of 13,800. The X ray shows an exaggeration of the lung markings, no fluid in pleural cavities. The sedimentation test (graph A) gives an almost straight diagonal line, indicating about the same activity as the clinical symptoms. Three days later the temperature became normal and remained normal. The pain gradually disappeared. On December 1, 1926, the recovery was apparently complete; he had gained 12 pounds in weight and appeared to be in excellent condition. The sedimentation rate had returned to normal. (See graph B.)

*Case 115* (fig. 24).—This patient has been in excellent health up to about a year ago, when he began to have "head colds" and "colds in the chest." He had just gone through such a cold when two days ago he began to have sharp piercing pains in the left side of the chest. Physical and X-ray examinations show typical findings of fluid in the left pleural cavity up to the level of the fourth spinous process. He has fever up to 102° F.; the leucocyte count is 8,200. The blood sedimentation is rapid (graph A) and emphasizes the acuteness of the condition. After a day in bed he began an uninterrupted improvement. The temperature became normal after

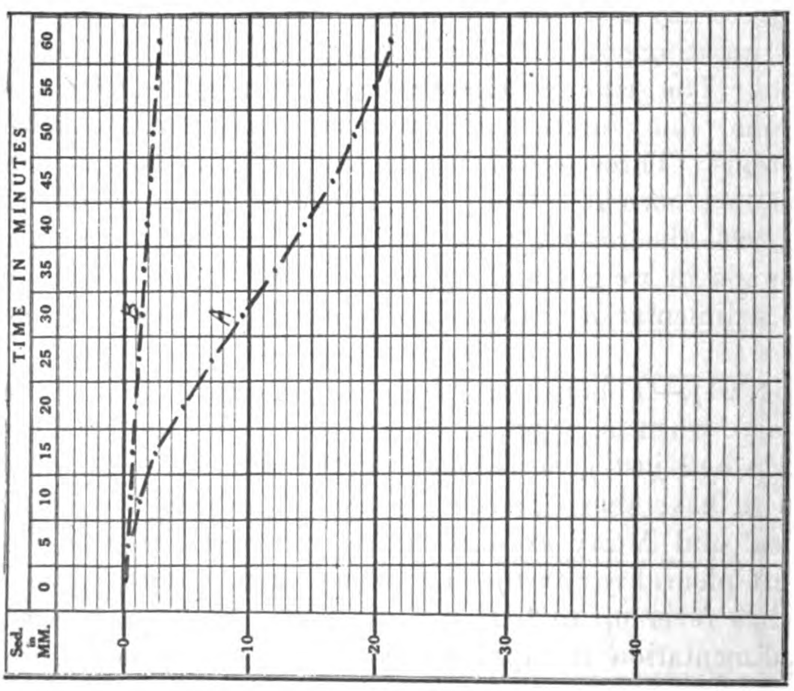


FIG. 23.—Sedimentation in fibrinous pleurisy. A, November 11, 1926: Onset three days ago; T., 99.3°, yesterday 102°; W. B. C., 13,800. B, December 1, 1926: T., normal, two weeks; no pain; has gained 12 pounds; apparently in excellent physical condition

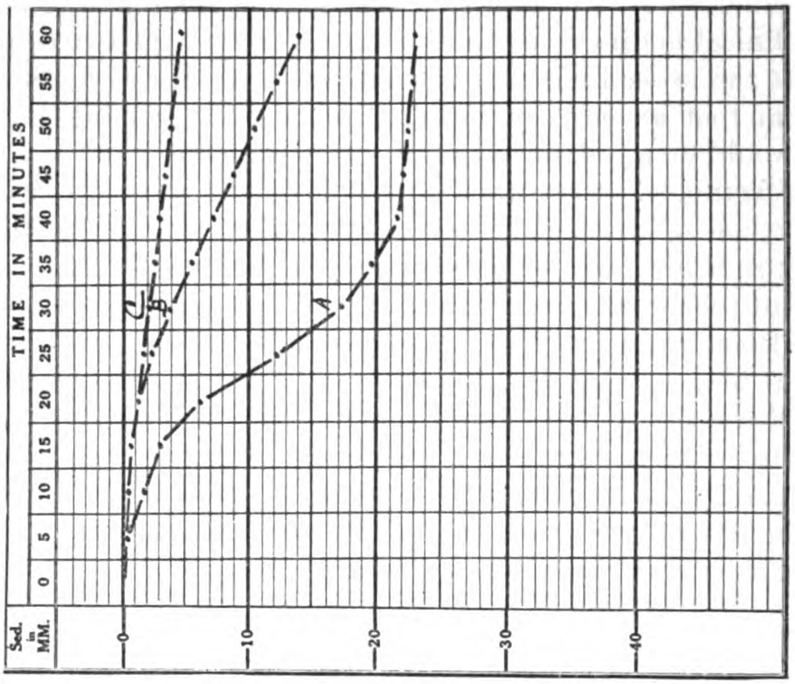


FIG. 24.—Sedimentation in serofibrinous pleurisy. A, October 20, 1927: Onset two days ago; fluid in left pleural cavity; T., 102°; W. B. C., 8,200. B, November 8, 1927: T., normal eight days; fluid decreasing; gaining weight. C, November 23, 1927: Convalescence completed

10 days, the fluid decreased, and he began to gain in weight. The second sedimentation test (graph B), taken 18 days after the first test, indicates a corresponding improvement. Convalescence continued and when the last test was done, five weeks after the onset, his general condition was excellent. There was still slight dullness at the base of the left lung and a röntgenogram showed the costophrenic angle obliterated. There were no physical or X-ray findings of any pathology in the lungs. All sputum examinations were negative for *B. tuberculosis* and a guinea pig inoculated with pleuritic fluid developed no pathology.

Pulmonary tuberculosis.—The blood sedimentation rate in pulmonary tuberculosis is intriguingly interesting. It is a clinical barometer rising and falling with the changing conditions and often forecasting the storms and calms of the disease. It seems to be the most sensitive indicator of the activity in the struggle between cells and bacilli. Long before the alarm of danger has speeded up the pulse rate and before the heat of battle has raised the body temperature, the erythrocytes begin to lose their buoyancy, as it were, sinking hopelessly from the very start. Rest and care may calm the racing heart and cool the feverish brow before the battle is over, but the sedimentation still mirrors the fighting, and again, when the enemy is being subdued and the battle front is quiet, although other clinical signs may fail to show convincingly the favorable change, the erythrocytes regain their buoyancy and reluctantly give way to the normal descent. These are our first impressions and perhaps later may prove to be too favorable.

Our series includes 14 cases of pulmonary tuberculosis. The clinical histories and sedimentation graphs of three cases containing the most points of interest are given below:

*Case 98* (fig. 25).—Admitted March 4, 1927. Male, white, age 24. He has been ill for five months with cough, anorexia, loss of weight and strength. Physical findings and X ray show extensive tuberculous involvement of both lungs, with cavity formation in the right middle lobe. Sputum positive for *B. tuberculosis*. Temperature remittent from 99° to 100° F.; pulse rate around 100. The sedimentation test taken on day following admission (graph A) gives the curve of marked activity, in agreement with the clinical picture. During the following six weeks he gained weight (4 pounds) and subjectively felt much improved. However, the fever continued to reach 100° F., with intermissions to normal and subnormal, and the pulse showed a gradual increase to around 106. The physical and X-ray examinations elicited no change. The sedimentation (graph B) changed slightly. It held an almost normal rate for the first 10 minutes, and then took a steeper dive to 1 mm. below the index of the

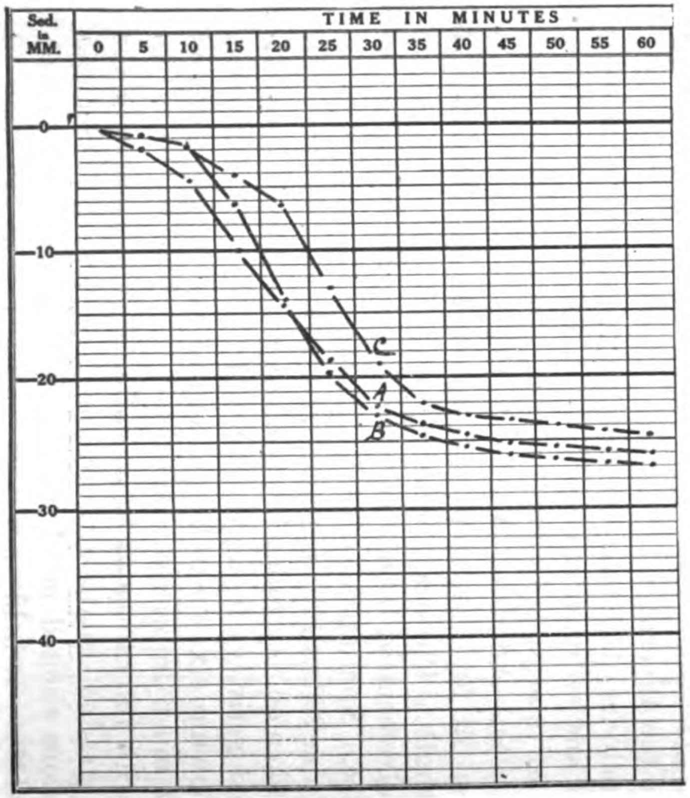


FIG. 25.—Sedimentation in pulmonary tuberculosis; conflicting clinical findings. A, March 5, 1927: Extensive tuberculous involvement of both lungs with cavitation; T., 99°–100°; pulse, 100. B, April 17, 1927: T., same; pulse has gradually increased to 106; has gained weight and feels better. C, October 7, 1927: No change in fever, pulse, or physical findings; has lost weight; feeling of improvement

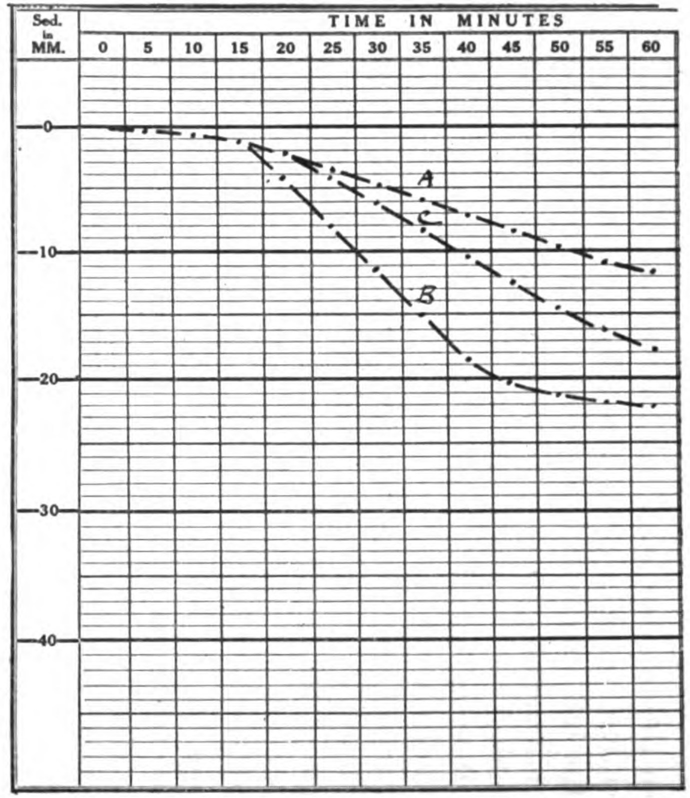


FIG. 26.—Sedimentation in pulmonary tuberculosis; increased activity shown by test before appearance of any other signs. A, March 17, 1927: Onset two months ago; coughed up tablespoonful of blood two weeks ago; no fever; pulse, 72; crepitant râles in right apex; X ray shows mottling in both apices. B, April 20, 1927: Improvement indicated by clinical findings, but 10 days later hemoptysis and fever to 102°. C, October 7, 1927: Gradual clinical improvement since last test

first test. It is probably correct to assume in view of the increase in pulse rate that even this slight change is significant of an increased activity. The next test was made six months later. During this time the fever and pulse continued about the same. No definite change in the physical signs could be made out; the X ray showed slightly less infiltration. He had lost 7 pounds in weight, but he felt much better and thought he had improved. With such conflicting evidence it is difficult to decide whether the patient had improved or become worse. The sedimentation (graph C) shows a less acute drop and a smaller index and probably correctly indicated a slight improvement.

*Case 52* (fig. 26).—Admitted March 16, 1927. Male, white, age 24. He gives a history of pleurisy in 1921 and again in 1923. In 1924 he had pneumonia with a protracted convalescence. Since then he has been in good health up to two months ago when he developed gastric symptoms: Nausea, vomiting, anorexia, and a dry hacking cough. Coughed up about a tablespoonful of blood two weeks ago. He has lost 10 pounds in weight. Physical examination shows recent loss of weight, hectic flush of cheeks, persistent crepitant râles in right apex. He has no fever; the pulse is 72. X ray shows mottling in both apices and in the right base. The sedimentation test (graph A) gives an almost straight diagonal line and like the temperature and the pulse indicates a relative quiescence. During the following month he had an occasional rise of afternoon temperature to 99° and 99.2° F., but otherwise the clinical condition suggested an improvement. The pulse remained normal, he gained 10 pounds in weight, and felt much improved. The sedimentation rate, however, shows a definite increase (graph B) and now suggests a relatively active process. The accuracy of the test became evident 10 days later when the patient had a hemoptysis, about 200 c. c., followed by fever up to 102° F., and a pulse rate of 110. This stormy activity calmed down within two weeks and there followed a gradual slow improvement. The third test was made almost six months after the hemoptysis. He then appeared to be in about the same condition as on admission. The pulse rate was around 72, the temperature normal, except for an occasional rise to 99° F. The X-ray film showed no change. In the sedimentation rate (graph C) there is a definite change for the better, much more so than one would estimate from the other clinical findings.

*Case 11* (fig. 27).—Admitted August 4, 1926. Male, white, age 23. He has had a cough for about a year, pain and soreness in the right side of the chest for seven months, night sweats occasionally for about four months, blood-tinged sputum during the last week. No

loss of weight. Physical findings: Expansion lagging in upper half of right side of chest; impaired resonance and cogwheel breathing in right upper lobe; temperature 99° F.; pulse rate 80. X ray shows haziness of the right apex and considerable density in the middle right lobe. Sputum positive for *B. tuberculosis.* Unfortunately the sedimentation rate was not taken until September 14, more than five weeks after admission. He then had had normal temperature for three weeks, except for an occasional afternoon rise to 99° F. The

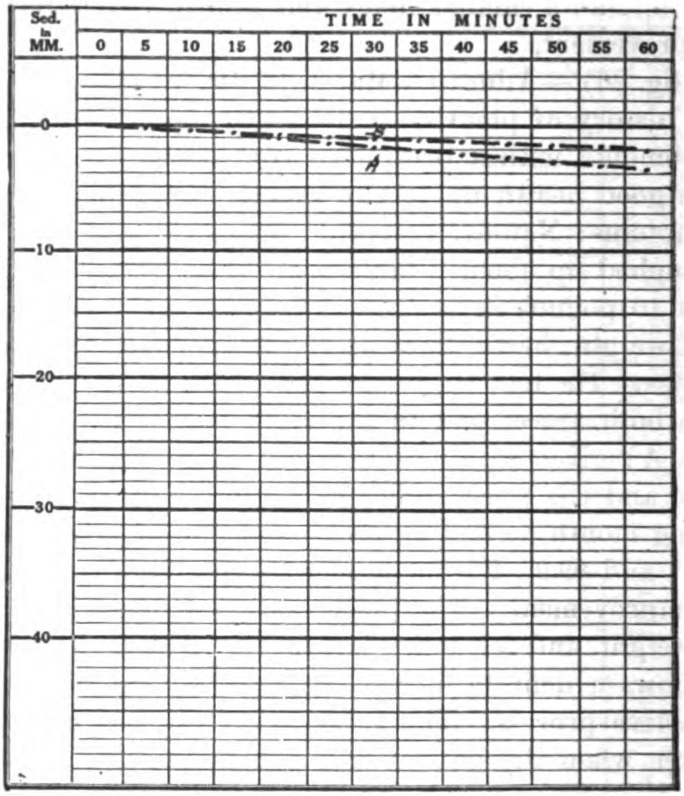


FIG. 27.—Sedimentation in pulmonary tuberculosis; normal rate although clinical findings do not indicate absolute quiescence. A, September 14, 1926: Onset a year ago; mild symptoms; blood-tinged sputum during past week; sputum positive for T. B. a week ago; occasional rise of temperature to 99°; pulse, 80. B, December 21, 1926: Excellent physical condition

pulse rate was around 80. Sputum had become negative. He had gained 15 pounds in weight and was feeling well and apparently in excellent condition. In view, however, of the recent signs of activity an absolute quiescence could hardly be presumed. But the sedimentation test (graph A) showed a normal rate. The subsequent course vindicated the test. The improvement continued. The temperature and pulse remained normal even after considerable exertion. He gained another 15 pounds in weight and felt as good as ever. The second sedimentation test taken December 21, 1926 (graph B),

showed an index of only 2 mm., which is within 0.5 mm. of the observed upper limit.

### COMMENT

In order to understand the clinical significance of the variations in the rate of sedimentation of red blood cells it is desirable, as in the use of other laboratory procedures, to have first-hand experience with the test. It is necessary to be convinced of the extreme sensitiveness of the test to the activity of the body cells incident to infections and other conditions influencing the suspension stability of the blood. It seems to be more sensitive in registering infections than any other clinical signs. In no case has the sedimentation rate been found normal when the relatively slow response of the temperature and the pulse or a leucocytosis have appeared.

Our experience so far has not revealed in the sedimentation test a means of positively differentiating tuberculous and nontuberculous pulmonary infections. It seems likely that a chronic bronchitis and an incipient pulmonary tuberculosis coming to a quick and complete quiescence may show identical series of sedimentation graphs. But in spite of this the test has been found of the greatest assistance in this problem of differential diagnosis. It has furnished a few guide-posts, which tentatively may be described as follows:

1. No case suspected of pulmonary tuberculosis can be free of suspicion so long as there is an abnormal sedimentation rate.
2. In cases of acute or chronic bronchitis a sedimentation rate which returns to normal shortly after the temperature becomes normal constitutes strong evidence against the infection being tuberculous.
3. A case of tuberculosis should not be considered in complete quiescence if the sedimentation rate has not returned to normal, even if no other symptom or sign of activity can be elicited.

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## PYELOGRAPHY AND URETEROGRAPHY

### Report of Cases

By Paul R. Stalnaker, Commander, Medical Corps, United States Navy

The urological service at the United States Naval Hospital, League Island, Pa., is a very active one and in it many interesting and instructive conditions are seen. The case reports which follow, and the photographs which accompany them, have been selected as illustrative of the varying types of cases encountered and are presented in the belief that they will prove instructive to naval medical officers.

No discussion of pyelography or ureterography is given, because the value of these procedures has been amply demonstrated and the technique by which they are accomplished is described in many standard works on urology.

A few conclusions, arrived at as a result of the experience afforded by these and other cases, are stated.

### Case Reports

*Case 1* (figs. 1 and 2).—N. M., veteran; April 9, 1926.

No. 24 BB cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine, 25 mils; light amber color, no shreds. Bladder capacity, 400 mils. There is slight congestion of areas around both ureteral orifices; ureteral function normal. Trigone red and injected even beyond interureteric ridge. No evidence of diverticula, trabeculations, tumors, stones, or foreign bodies. No. 6 catheter passed to right kidney pelvis with ease, and a No. 6 catheter passed about 4 inches up left ureter, where it met an obstruction and would not pass further. Sterile specimens of urine collected from both sides and sent to laboratory show now microorganisms. Culture on plain agar and bouillon from both kidneys show no growth. Guinea pigs inoculated with sediment from sterile specimens of urine from both kidneys show no evidence of tuberculosis.

X-ray pictures show slight kink in right ureter and some indication of beginning early hydronephrosis of right kidney.

*Case 2* (fig. 3).—P. C. C., veteran; May 3, 1927.

No. 24 BB cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine none. Vesical orifice, irregular and jagged. There are a number of red areas over entire bladder. No stones, tumors, or foreign bodies seen. Right ureteral orifice is larger than normal and gaping. Left ureteral orifice not quite so large as right. Verumontanum is larger than normal.

No. 6 catheters passed to both kidney pelves. Sterile specimens collected and sent to laboratory show no evidence of tuberculosis. Cultures on plain agar and bouillon show no growth.

Pyelograms of both kidneys taken after 15 mils of a 12½ per cent solution of sodium iodide was instilled, show distortion of both kidneys and a small stone in upper part of left kidney.

Impression: Renal calculi.

*Case 3* (fig. 4).—W. A. D., ensign, U. S. Navy; September 21, 1927.

This patient gave a history of kidney colic and hematuria.

No. 24 BB cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine none. Trigone red and congested. Interureteric ridge slightly raised and well defined. The ureteral orifices are close together and slightly raised. The right ureteral orifice functions normally but the left is red and congested and does not have a normal function. Otherwise the bladder looks normal. No stones, tumors, or foreign bodies seen.

No. 6 catheters passed to both kidney pelves. Sterile specimens collected and sent to laboratory show few leucocytes, numerous red blood cells, numerous calcium oxalate crystals, no acid-fast bacilli.

Cultures on plain agar and bouillon show no growth.

Two hour medical P. S. P. test shows a 12 per cent elimination for first hour and a 10 per cent elimination for second hour.

Pyelogram of left kidney, after instillation of 14 mils of 12½ per cent sterile sodium iodide solution, shows the kidney pelvis and calyces well filled with opaque solution. The pelvis is smooth, rounded, and slightly dilated. The calyces are shortened and considerably broadened. The kidney itself is smooth in outline, but slightly larger than normal, and appears to be rotated, with pelvis anterior. The ureter leads off anterior surface downward and medially.

IMPRESSION: Moderate hydronephrosis as the result of anterior rotation of left kidney, which produces a kink at the uretero-pelvic junction.

Left kidney pad advised. Patient was sent to duty much improved.

*Case 4* (figs. 5 and 6).—R. B. B., captain, U. S. M. C.; August 23, 1926.

This patient gave a history of hematuria and pain.

No. 24 BB cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine, 50 c. c.; cloudy. Bladder capacity, 500 c. c.

A few trabeculations in bladder. Trigone slightly raised. No stones, tumors, or foreign bodies seen. No. 6 catheters passed to both kidney pelves. Sterile specimens collected and sent to laboratory show no acid-fast bacilli. Cultures on plain agar and bouillon show no growth. Guinea pigs inoculated with specimen of urine from each kidney were negative for tuberculosis.

Pyelogram of left kidney, after instillation of 10 mils of 12½ per cent solution of sodium iodide, shows the kidney pelvis well filled with opaque solution. The upper calyx shows slight distortion, probably the result of dilatation. The left ureter shows slight irregularity in its course, about 2 inches below the kidney pelvis, and suggests the possibility of constriction resulting from kink. No evidence of calculi. Reexamination of the left kidney by aid of pyelogram shows kidney pelvis to be slightly larger than normal. A suggestion of the kink previously reported is shown to be due to faulty filling at that time. The clubbing of the calyces is still present.

IMPRESSION: Early hydronephrosis.

Third examination of left kidney by aid of pyelogram shows a distinct kink of the ureter just below the kidney pelvis, which is obliterated by passing of ureteral catheter. Pyelogram of right kidney shows a distinct kink of the right ureter just below kidney pelvis. The ureter appears normal in size. No evidence of calculi. Both kidneys show decided ptosis with ureteral kinking. Bilateral kidney pads worn by patient greatly relieved his abdominal distress and he rapidly gained over 10 pounds in weight.

*Case 5* (fig. 7).—C. Q. H., sea. 2c., U. S. Navy; July 15, 1926.

No. 24 BB cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine, 25 mils; clear. Bladder capacity, 350 mils. Bladder is very red and irritable, and has a small amount of mucus throughout. There are a few trabeculations in bladder. No stones, tumors, or foreign bodies seen. No. 6 catheters passed to both kidney pelves. Sterile specimens collected show no acid-fast bacilli. Cultures on plain agar and bouillon show no growth.

Pyelogram of left kidney, after instillation of 15 mils of 12½ per cent solution of sodium iodide, shows a large staghorn calculus in the kidney pelvis. At least partial function of left kidney was indicated at cystoscopy.

Transferred to the surgical service, where the diagnosis was confirmed and a nephrectomy was performed. Patient had an uneventful recovery and was discharged to duty well.

*Case 6* (fig. 8).—McC. K., veteran; November 21, 1927.

No. 24 BB cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine, none. Bladder very irritable. Blood vessels around the trigone stand out very prominently. Prostate, slightly enlarged intravesically. No stones, tumors, or foreign bodies seen.

No. 6 catheter passed fully into right ureter and a No. 4 catheter was passed about 3 inches into left ureter. Sterile specimens taken and sent to laboratory show no casts, few pus cells, no bacteria.

Cultures on plain agar and bouillon show a growth of staphylococci.

Pyelogram of left kidney, taken after instillation of 22 mils of a 12½ per cent solution of sterile sodium iodide, shows the kidney pelvis and calyces well filled with opaque solution. There is a moderate distention of the pelvis and major calyces and blunting of the minor calyces. The ureter shows rather marked distention.

IMPRESSION: Moderate hydronephrosis, result of ureteral calculus, which is situated near the junction of the ureter and the bladder.

This patent was cystoscoped again and the left ureteral orifice was enlarged with cystoscopic scissors. Later a No. 11 Garceau catheter was passed 20 centimeters up the left ureter and sterile olive oil instilled.

Financial reasons forced this patient to leave the hospital to go to work. He will be followed later.

*Case* 7 (fig. 9).—E. L. R., M. M. 2c., U. S. Navy; November 22, 1927.

No. 24 BB cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine, none. Trigone very red and congested. Ureteral orifices normal in position. No stones, tumors, or foreign bodies seen. No. 6 catheters passed to both kidney pelves. Sterile specimens collected; show no microorganisms. Cultures on plain agar and bouillon show no growth.

Pyelograms taken of each kidney after instillation of 12 mils of 12½ per cent sodium iodide solution show the kidney pelves and calyces well filled with opaque solution and apparently normal in shape and contour. Both kidneys show congenital double pelves. The right ureter shows a slight kink as it dips down into true pelvis.

IMPRESSION: Kink in right ureter, which is clearly visible in pyelogram. This patient is to be further studied with a view to correcting this kink.

NOTE.—Later this patient refused to remain longer for study at this time but promised to return later. He is one of the few cases in which double pyelograms were taken. No ill effects shown.

*Case* 8 (figs. 10 and 11).—J. P. M., B. M. 1c., U. S. Navy; October 28, 1927.

No. 24 Brown-Burger cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine, 35 mils; cloudy and full of débris. Bladder very red and congested. One small pebble stone seen in bladder. Right ureteral orifice is larger than normal, very red and congested, and quite puffed out. Left ureteral orifice appears normal. Trigone red and congested. No. 6 catheters passed to both kidney pelves. Sterile specimen of urine collected from right kidney shows many pus cells, no casts, numerous staphylococci. The largest contituent of sediment is pus. Cultures on plain agar and bouillon from right kidney show growth of staphylococci. Pyelogram of right kidney, after instillation of 8 mils of a 12½ per cent solution of sodium iodide, shows an irregular area of increased density at the lower pole, which is rough and circular in outline, measuring approximately 1$\frac{3}{16}$ centimeters in diameter. There is a second area about 1 centimeter above this area which is about 8 millimeters in diameter. The third circular area of increased density can be made out at the junction of the ureter with the pelvis of the kidney, which measures roughly 12 millimeters in diameter and appears to act as a valve, blocking the outlet of the kidney. The kidney itself is well outlined, suggestive of distention from fluid.

IMPRESSION: Nephrolithiasis with periureteral obstruction.

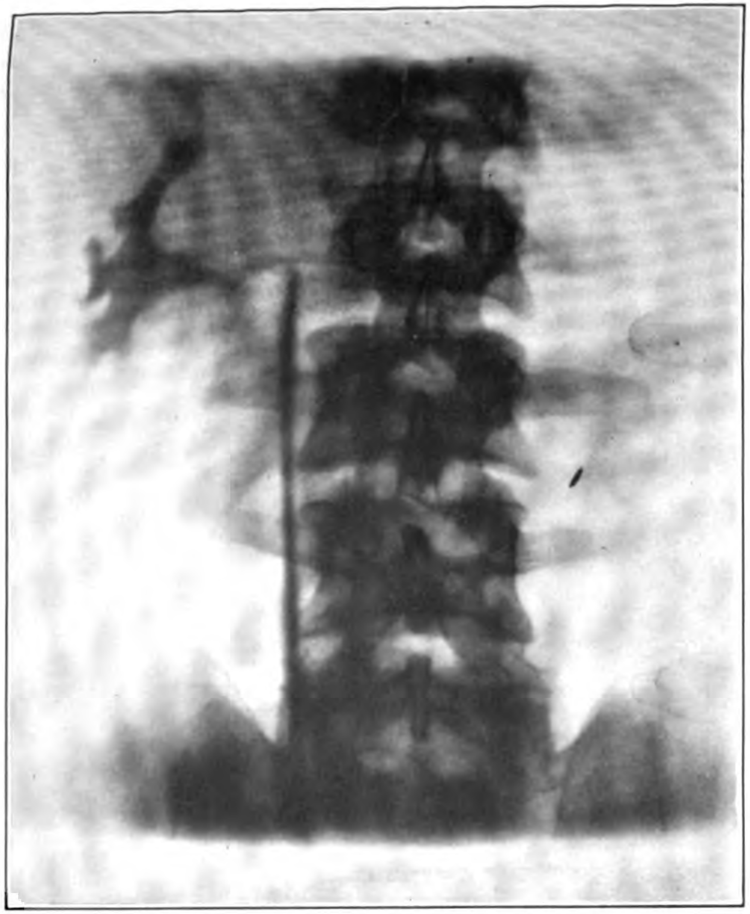

Fig. 1.—Case 1. Slight kink in right ureter with calyx distortion and beginning hydronephrosis

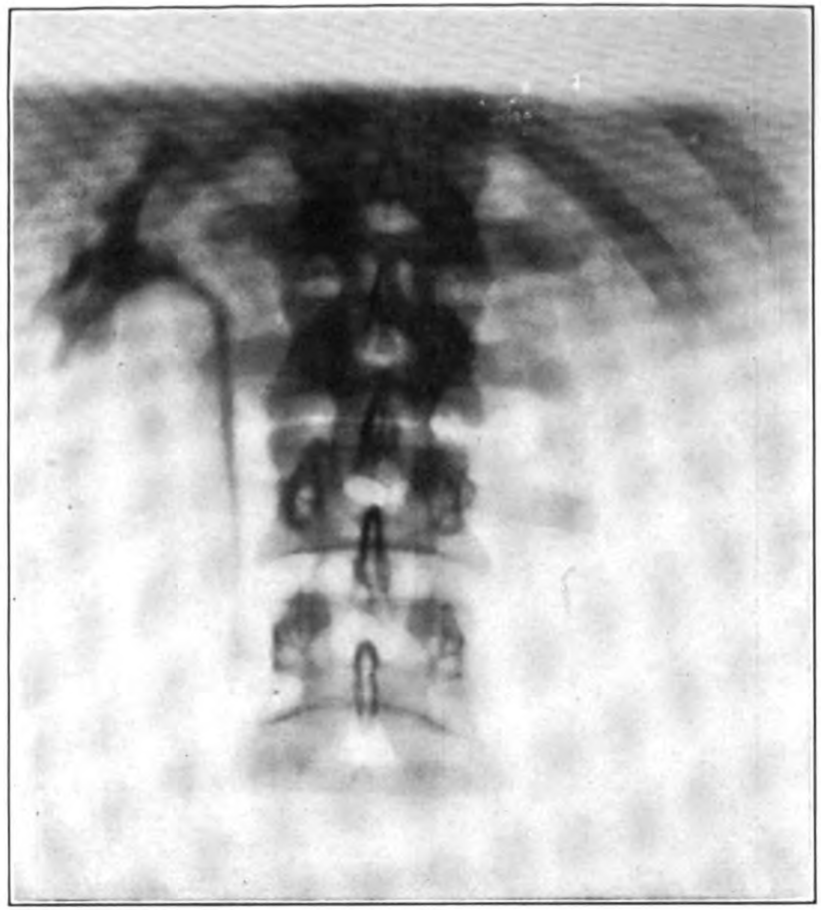

Fig. 2.—Case 1. Kink in ureter has disappeared due to presence of ureteral catheter

Fig. 3.—Case 2. Pyelograms of both kidneys taken at different times show distortion. Small stone in upper part of left kidney

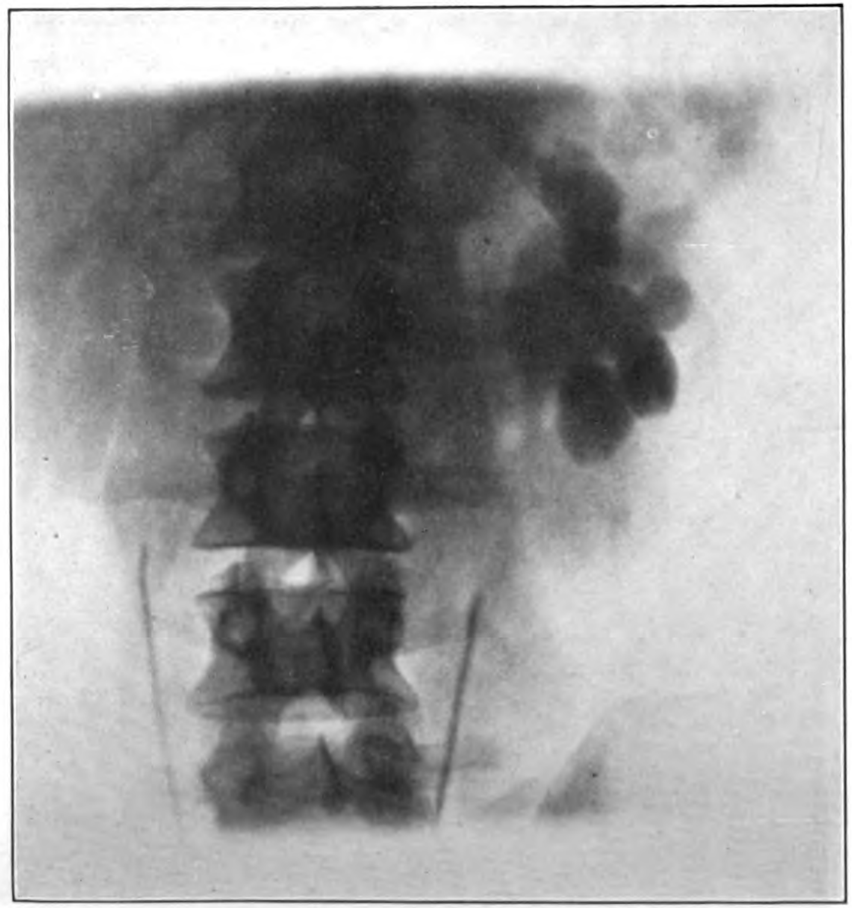

Fig. 4.—Case 3. Moderate hydronephrosis due to anterior rotation of kidney causing kink at ureteropelvic junction

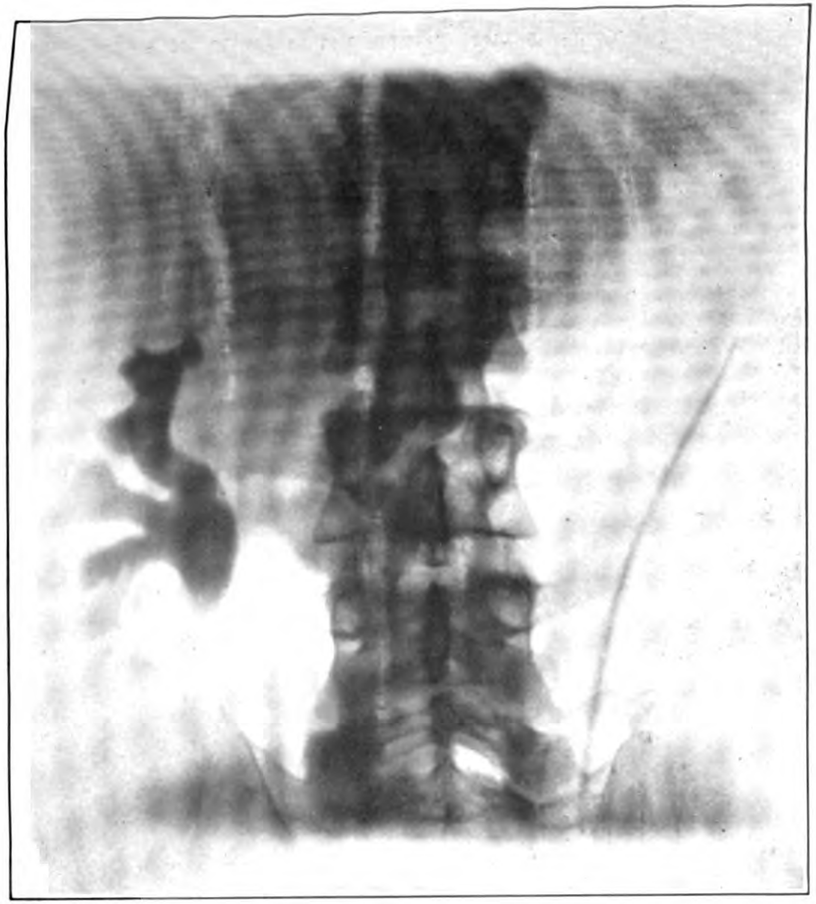

Fig. 5.—Case 4. Right side shows kink and ptosis with moderate hydronephrosis. Kink on left side

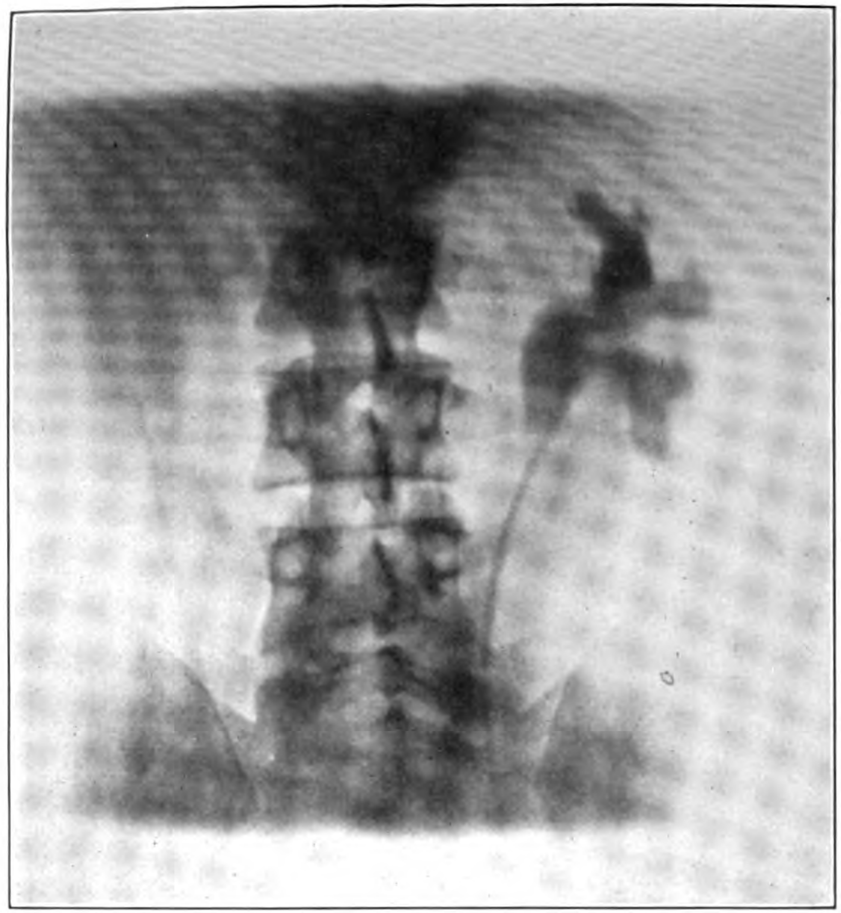

Fig. 6.—Case 4. Left side. Kink on left side obliterated by catheter. Shows value of taking pyelograms with and without catheter

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Fig. 7.—Case 5. Stones in left kidney. Note distortion and filling defect

Fig. 8.-- Case 6. Large stone at ureterovesical junction. No pyelogram possible because of blocking

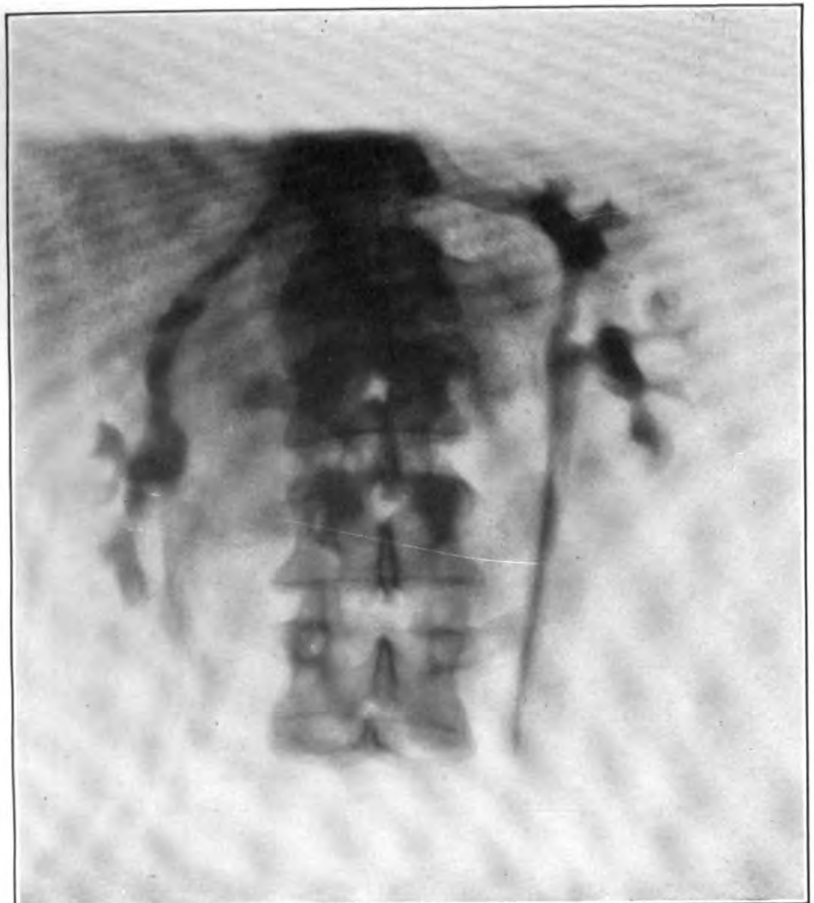

Fig. 9.—Case 7. Double pyelogram showing congenital double pelvis. Slight kink in right ureter as it dips into true pelvis

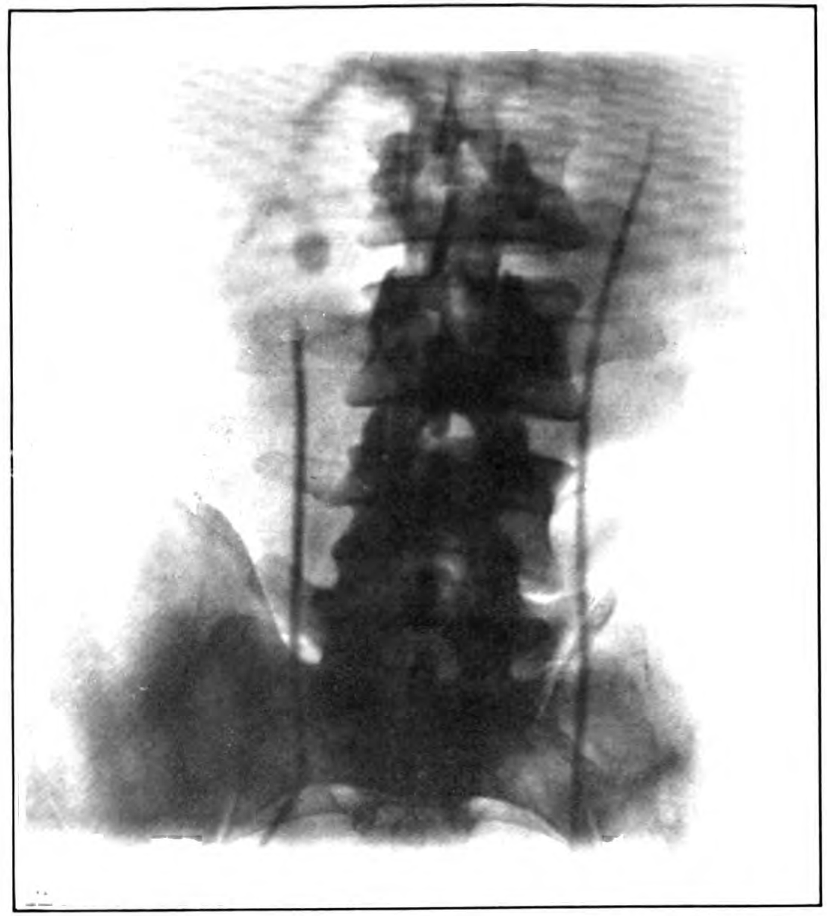

Fig. 10.—Case 8. Catheter in right ureter just before reaching ball-valve kidney pelvis stone

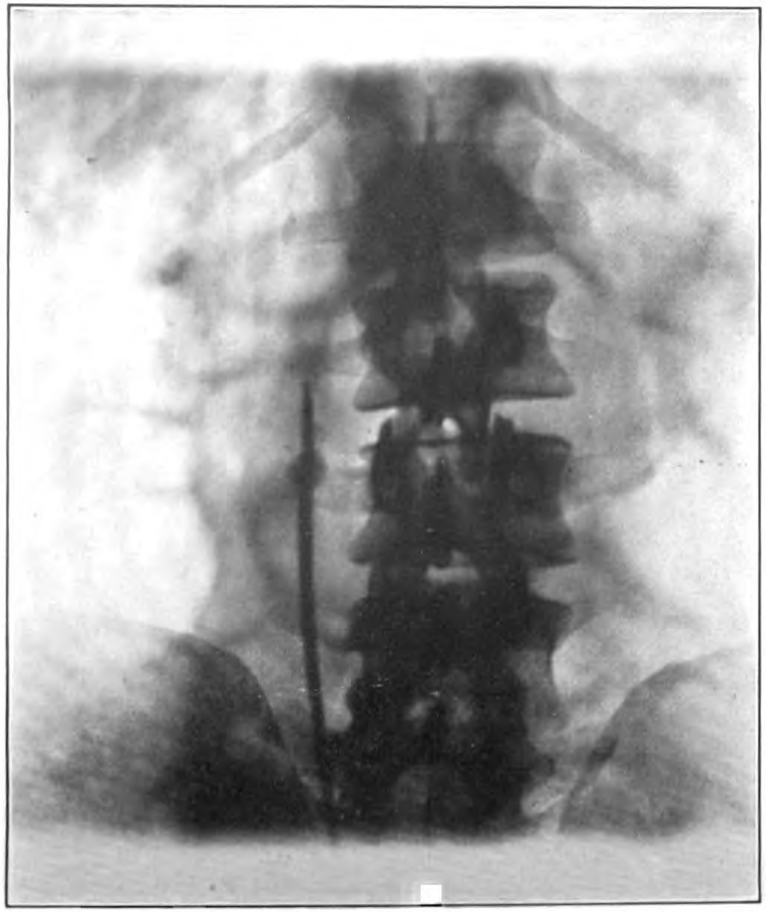

Fig. 11.—Case 8. Catheter has passed beyond stone and dislodged it from its dependent position

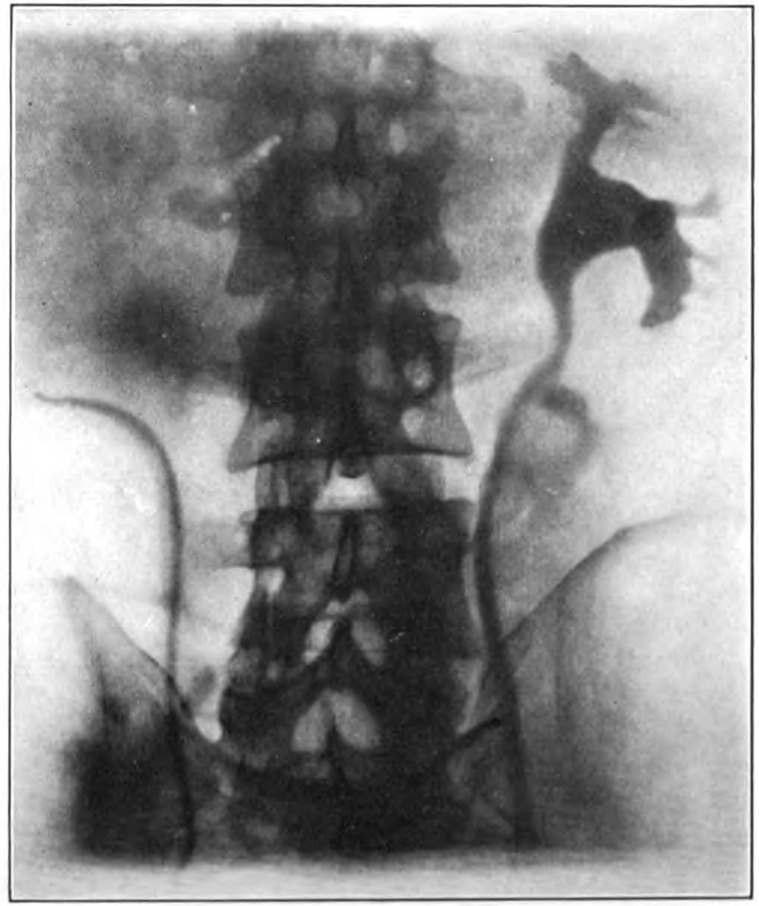

Fig. 12.—Case 9. Distortion of pelvis (left) with stone and kink in ureter

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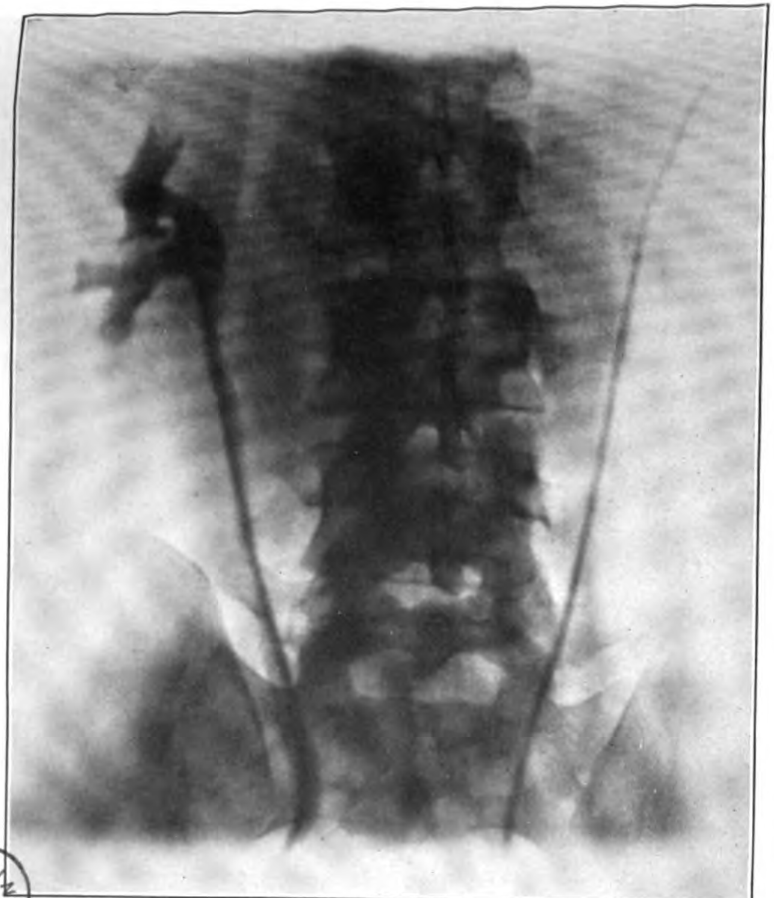

Fig. 13.—Case 10. Distortion and irregularity of upper calyx. Probably tuberculosis of right kidney

Fig. 14.—Case 11. Movable left kidney and decided kink in left ureter

Fig. 15.—Case 12. Small stone in lower end of ureter was removed by repeated ureteral dilatation. Slight distortion of kidney pelvis

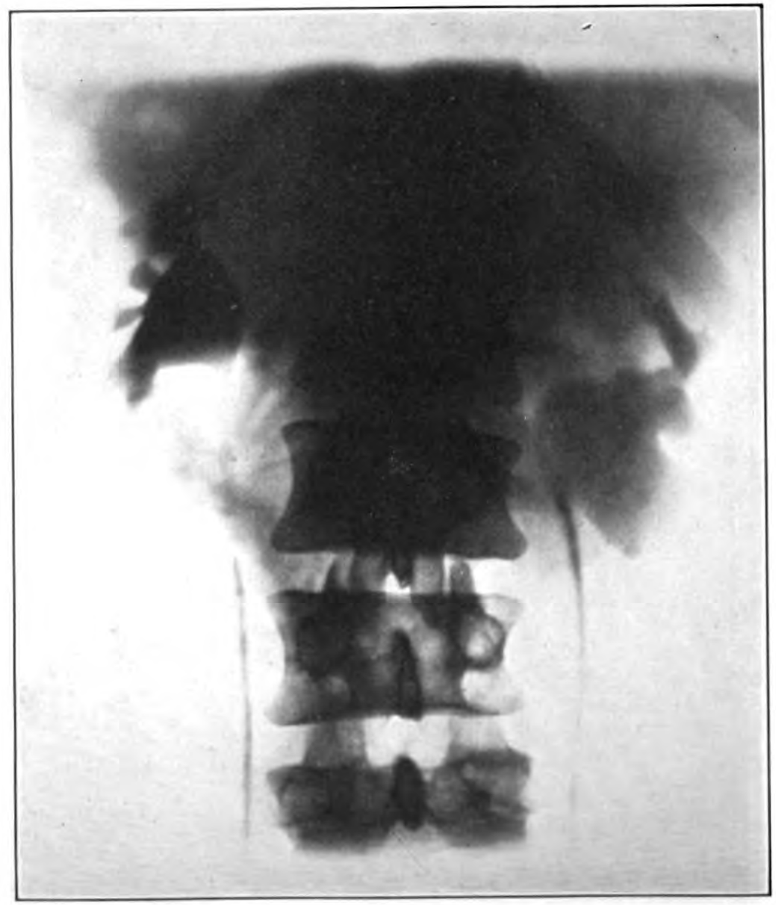

Fig. 16.– Case 13. Moderate hydronephrosis of both kidneys. No harmful effects resulted from double pyelogram

Transferred to surgery where a nephrotomy was performed by Commander McDowell and several small stones removed. Patient did well for several days when the right ureter again became blocked and a No. 11 Garceau catheter had to be inserted via the cystoscope and left in for several days. Kidney drains freely with ureteral catheter in situ, but stops functioning as soon as removed. Another ball valve stone is present and blocks right ureter. Reexamination of right kidney shows rather marked increased density and distortion in this area.

There is an irregular calcified area apparently in upper portion of kidney, while the second circumscribed area which was seen in previous picture is present in the region of uretero pelvic junction.

IMPRESSION: Nephrolithiasis with postoperative adhesions.

*Case 9* (fig 12).—L. L., veteran; November 4, 1927.

No. 24 BB cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine, 75 mils; cloudy. Vesical neck, normal. Prostate, slightly enlarged intravesically. The ureteral orifices are small. No stones, tumors, or foreign bodies seen. No. 6 catheter passed to right kidney pelvis, and a No. 6 catheter passed 10 cm. up left ureter. Sterile specimens collected and sent to laboratory show no acid-fast bacilli. Cultures on plain agar and bouillon show no growth. Pyelogram of left kidney, after instillation of 12 mils of 12½ per cent sodium-iodide solution, shows the kidney pelvis and calyces well filled with opaque solution. There is an area of increased density in the central portion of the kidney, measuring approximately 7 by 12 millimeters in its greatest dimensions. The minor calyces have normal appearance. There is a kink in the left ureter at the uretero-pelvic junction.

IMPRESSION: (*a*) Stone in left kidney; (*b*) Kink in left ureter.

This patient also had syphilis and while taking a course had to leave and go to work to support a large family. He promised to return later for further study and possible operation.

*Case 10* (fig. 13).—G. H. E., veteran; April 27, 1927.

No. 24 BB cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine, none. Right ureteral orifice has a red area around it, is very small, and not clearly defined. Left ureteral orifice is hard to find. There are several red spots scattered throughout bladder; also a number of trabeculations. Trigone red and congested. Posterior urethra very red, especially around verumontanum.

No. 6 catheters passed to both kidney pelves and sterile specimens of urine collected. These show numerous pus cells; no acid-fast bacilli. Cultures on plain agar and bouillon show no growth. Specimen from right kidney was centrifuged and the sediment inoculated in a guinea pig. The pig was positive for tuberculosis.

Pyelogram of right kidney, after instillation of 9 c. c. of 12½ per cent solution of sodium iodide, shows the upper calyx slightly irregular and distorted, which suggests tissue destruction.

IMPRESSION: Tuberculosis of right kidney.

*Case 11* (fig. 14).—M. M., civilian; May 13, 1927.

No. 24 Brown-Burger cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine, none. Bladder looks normal. Ureteral orifices, normal in position. The right ureteral orifice is slightly larger than the left. Trigone is raised and the blood vessels stand out more prominently than normal. No stones, tumors, or foreign bodies seen.

No. 6 catheters passed to both kidney pelves. Sterile specimens collected and sent to laboratory show no casts or acid-fast bacilli. Cultures on plain agar and broth show no growth in either kidney.

Pyelogram of left kidney taken after instillation of 10 mils of a 12½ per cent sodium iodide solution, shows the kidney pelvis and calyces well filled with opaque solution. There is a slight distortion from respiratory motion; however, the pelvis and calyces appear normal. There is no evidence of calculi. The right kidney appears to be normal in size and shape, but appears to change position slightly in the different pictures, which is suggestive of some mobility.

FINAL DIAGNOSIS: Movable left kidney.

A left kidney pad and a fattening diet greatly improved this patient.

*Case 12* (fig. 15).—C. N. V., Sea. 2c., U. S. Navy; June 23, 1926.

No. 24 BB cystoscope passed with ease; no discomfort to patient; no anesthetic used. Residual urine, 15 mils; clear. Bladder very red and irritable. Few cellules found near left ureteral orifice. No stones, tumors, or foreign bodies seen. No. 6 catheter passed to right kidney pelvis and sterile specimen collected. Shows no evidence of tuberculosis. Cultures on plain agar and bouillon show no growth.

Pyelogram of right kidney, after instillation of 9 mils of 12½ per cent solution of sodium iodide, shows a shadow in the lower end of the right ureter, apparently just posterior and medial to the catheter, which is probably a small stone imbedded in a small pouch in the ureter. After repeated right ureteral dilatations with No. 11 Garceau catheters and instillation of sterile olive oil in kidney pelvis this stone in ureter was finally passed and patient was discharged to duty well.

Pyelogram of left kidney shows no evidence of stone.

*Case 13* (fig. 16).—N. B., veteran; April 26, 1927.

No. 24 BB cystoscope passed with ease; no anesthetic; no discomfort to patient. Residual urine, none. Trigone raised, red, and irregular. There is a slight beginning median bar. Vesical neck appears normal. Ureteral orifices large and well defined. Posterior urethra red and congested. There is a small cyst in posterior urethra. Verumontanum looks red and congested. No stones, tumors, or foreign bodies seen.

No. 6 catheters passed to both kidney pelves and sterile specimens collected. These show no microorganisms. Cultures on plain agar and bouillon show no growth.

Pyelogram pictures, taken after instillation of 10 mills of a 12½ per cent solution of sodium iodide in each kidney, show the kidney pelves rather dilated and the limbs of the calyces shortened and broadened.

IMPRESSION: Moderate hydronephrosis of both kidneys.

## CONCLUSIONS

(1) Unilateral pyelograms are the rule. There is too much risk in taking bilaterals and this should never be undertaken except under extreme circumstances and by experts.

(2) In both renal lithiasis and renal tuberculosis, phenolsulphonephthalein and indigo-carmine tests are notoriously uncertain and unreliable.

(3) Ureterograms by the two-catheter method are preferable to leaving X-ray catheters in situ.

(4) Often, movable kidney causes more trouble after the patient knows of the condition than before. Suspension operations are often failures. Frequently, abdominal kidney-supporting binders and fattening the thin patients are effective.

(5) Before removing appendices for indefinite and indeterminate right-sided abdominal pains, differential kidney function tests and pyelograms should be made to exclude renal pathology. Many sound appendices have been removed when right renal pathology existed.

(6) Anesthesia for cystoscopy is not generally necessary, tuberculous bladders excepted. In nearly 1,000 cystoscopies it has not been employed half a dozen times and the patients have not been pained. It largely depends on the dexterity of the operator in the handling of the instrument. Keep the cystoscope off the trigone and the average patient will never complain.

(7) The average plain cystoscopy should not consume over 5 to 10 minutes. Deliberateness, precision, and speed are the watchwords.

(8) All bladder tumors are potentially malignant and should be so treated.

(9) The best medium for pyelographic work is now generally accepted as a 12½ per cent solution of sterile sodium iodide.

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## SCABIES TREATED WITH THE DANISH TREATMENT

### Report of 60 Cases

By John B. Kaufman, Captain, Medical Corps, United States Navy

Until about seven months ago all cases of scabies occurring in the personnel of the naval training station, San Diego, Calif., were treated in the routine manner generally outlined in textbooks and commonly carried out in the naval service. This treatment, briefly, consisted in thoroughly washing all parts of the body with hot water and soap, supplementing this with the use of a brush on those areas where the skin would permit of its use. Following this a sulphur ointment was rubbed in vigorously over the entire surface, with particular attention to those sites where the eruption was most pronounced. This ointment rubbing was persisted in bidaily for a variable number of days, during which the patient kept continuous company with his original underwear. Ten hours or so after the final application of the ointment he needed no urging to bathe and don clean clothing. The usual precaution was taken to sterilize all personal articles of clothing as well as bed linen, mattress, etc., that might come in contact with the patient's body. With this ac-

complished he was discharged to duty with a sick-day record of four days or more, and readmissions were not rare. It was this large number of sick days that decided us to institute the Danish treatment and study the results. This treatment, while theoretically known to us, had so many adverse criticisers that our practical inexperience with it rather made it an experiment. The adverse opinions were mainly directed at its extreme irritation, disagreeable odor, and lack of end results.

The treatment as outlined is as follows:

The patient receives an ordinary cleansing bath with soap and warm water, drys himself thoroughly, and, following this, rubs the whole of his body, except the head, with the ointment. Hard rubbing is not desirable. After the completion of the ointment application the patient waits a quarter of an hour and then dons his underwear or pajamas and turns in. The next day, at about the same time, he receives a second bath and fresh clothing. The same sterilization process is followed as is prescribed for the older (sulphur ointment) treatment.

It was obvious to us that there were several precautions to be taken in order to test this treatment carefully, and these will be outlined with the hope that they will produce the same good end results that we have obtained.

Perhaps the most important precaution to be observed is in the *preparation of the ointment.* In the original article describing the treatment the following method of preparation was specified:

(*a*) One kilogram of sublimated sulphur is dissolved at gentle heat in 2 kilograms of a 50 per cent solution of potassium hydroxide.

(*b*) Two hundred and twenty-five grams of vaseline and 225 grams of water-free lanoline are carefully mixed without heating.

(*c*) To this mixture 375 grams of the solution of sulphur in potash lye (*a*) is added.

(*d*) Fresh zinc hydroxide is prepared by mixing 28 grams of zinc sulphate and 40 grams of 20 per cent sodium hydroxide, and this is afterwards added to the ointment.

(*e*) Liquid paraffin is added to obtain a total weight of 1,000 grams.

(*f*) Five grams of benzaldehyde is added to check the somewhat disagreeable smell of sulphuretted hydrogen.

In our experience here we have not found it necessary to incorporate the benzaldehyde and have eliminated (*f*) in the preparation of the ointment.

There are certain definite precautions to be taken. Great care should be exercised to see that the proper amounts of sulphur and 50 per cent solution of potassium (not sodium) hydroxide are heated together at a temperature not too high but sufficient to result in a clear, dark-colored (reddish brown) liquid. When cooled slightly (luke warm) add the petrolatum and lanoline, which have previously

been mixed (rubbed together without heat), and then add the freshly prepared zinc hydroxide and other ingredients. It is decidedly important to observe that heat enters into the preparation only when the sulphur and potassium hydroxide are mixed, and all other steps are conducted at room temperature. Ordinary potash lye will not produce results and potassium hydroxide c. p. is required. This is not an item of the Supply Table, Medical Department, United States Navy.

*Supervision of treatment.*—In addition to the cases reporting at sick call, recruits are examined carefully for lesions of the disease at body inspection on each Saturday morning by two medical officers. One medical officer has sole charge of all cases, examines every patient, charts the lesions, and directs treatment; he, furthermore, examines them the day after the administration of treatment and holds a weekly "scabies clinic" to determine the progress of each individual, and renders the final decision as to whether or not each case is definitely cured. When this method is systematized, as it is here, it takes but little time and it is extremely important in getting results.

*Application of ointment.*—Each case is treated under the direct supervision of a competent corps man and no patient is allowed to carry out his treatment without such supervision. In this manner we avoid, as much as possible, the probability of the ointment not being properly applied. The undesirability of hard rubbing with the ointment is impressed.

*Mistaken symptoms.*—In some cases there has been noted the day after treatment slight itching or even a slight stinging sensation. It is definitely important to wait 24 hours or more to see whether or not further treatment is necessary or, as is the usual case, to determine that the symptoms are due to the irritation excited by the sulphur. Furthermore, in an occasional case, a moderate, eczema-like eruption has been noted in a sensitive skin, provoked by the scratching or perhaps by the ointment, and it is necessary to apply some soothing ointment. In either of these classes of cases it is most important that the treatment be not repeated so long as it is possible that the symptoms are the result of irritation due to the scratching or treatment and not to the parasite itself. It is particularly to be impressed that hasty conclusion as to the result of treatment must not be made. Our experience has taught us that many cases (particularly the severe ones) after treatment will, for several days, retain the appearance of being still infected and yet, without further treatment, clear up gradually and completely.

In the 60 cases here presented the notes of the examining medical officer indicate in several a skepticism at first as to the efficacy of the treatment, due to the fact that for several days following the applica-

tion of the ointment there still persisted some itching and there appeared still to remain the lesions of the disease. However, a repetition of the treatment was wisely withheld and all subjective and objective symptoms gradually disappeared. Of the 60 cases treated 26 were of the severe or advanced type and gave every evidence of having been infected for some time. In all of these the distribution of the lesions was more or less general. In the remaining 34 cases the eruption was, for the most part, confined to the arms, thighs, buttocks, and penis. In one of the severest cases the patient had been treated several times with sulphur ointment. Although only the one Danish treatment was given him six months ago, there has been no return of the infection. One treatment only, as outlined, has been administered in all except seven cases, and a careful check of these has demonstrated a positive cure. Of the exceptions, case 1 was an extremely severe one; after the first treatment he was thought cured and five months later he was again admitted with scabies, and with one treatment again presumed to be cured. In cases 2, 3, 4, and 5, after the first treatment there was a marked improvement, but a second treatment was necessary in three weeks. The lack of results pointed definitely to improper sterilization of clothes and bedding by an inefficient corps man and was, in our belief, pure reinfection from this source.

Case 6 was mild and the regular treatment was given with ointment freshly prepared in the drug room that day. This ointment proved to have been improperly made, double the quantity of potassium hydroxide being used, and the man was rather severely irritated soon after the application. The ointment was removed from his body and treatment instituted for the irritation which presented all the signs of a moderately severe burn. When these symptoms had disappeared he was again placed on treatment and cured with one application. The wrongly prepared ointment was used only on this case and was immediately destroyed. Case 7 was the most severe and advanced of all the cases treated, the lesions covered the entire body, except the head, and the patient stated that he had only noticed the itching about one week before presenting himself for treatment. The first application of the ointment apparently effected a cure, but one month later there were still many lesions and a second treatment was administered with the same apparent good results. After another month had passed he again showed unmistakable evidence of active scabies, and a third treatment was given. The patient is still under observation, though apparently cured. Complete sterilization was carried out in this case, the ointment was properly made and applied, and, lacking any specific cause for the negative results, it should be noted as a failure.

Of the cases cited no man was on the sick list and absent from his duties for more than one day except the few requiring more than one treatment. It will therefore be seen that the saving of sick days was most gratifying to us when we recalled our past experience with the sulphur-ointment treatment.

If the same good results can be obtained generally, it is suggested that it might be advisable to include the ointment as an item of the Supply Table. Whether or not it is sufficiently stable to be prepared in bulk and issued in this manner, we are unable to state; also, we are not prepared to assert whether or not the nature of the container would be a necessary factor to consider. Recently we have put aside some ointment in a glass jar to be kept under average conditions and will in about six months use it on a scabies case that may present itself at that time. Some of the lesions will be treated with a freshly prepared ointment, while others will be subjected to the ointment that has been stored.

In carrying out this treatment and presenting the record of each individual case I am indebted to my assistants, Lieutenants Farmer, Bowles, and Childs, Medical Corps, United States Navy, and for the careful supervision of the preparation of the ointment to Chief Pharmacist Alexander, United States Navy.

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## TRANSFIXION WOUND OF NECK[1]

### REPORT OF CASE[2]

By JAMES M. TROUTT, M. D., B. A., F. A. C. S., Major, Medical Corps, United States Army, Surgical Service, Tripler United States Army General Hospital, Honolulu, Hawaii

This case is reported purely as a curiosity and as an illustration of the great trauma the tissues of the human body can withstand.

Ralph L., white, seaman, second class, United States Navy, age 22 years, was admitted to Tripler General Hospital November 4, 1927, as a litter emergency case following an automobile accident. The car he was driving skidded and went through a picket fence on the roadside. He had been impaled on one of the pickets, a portion of which transfixed the soft tissues of the neck.

Two large splinters of wood projected from punctured skin wounds in the lower part of the occipital triangle of the right side of the neck. About 8 centimeters of the larger splinter was showing, its end being just above the right acromion; 4 centimeters of the smaller splinter stuck out in the same plane, just above and in front of the larger one. The direction of the splinters

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[1] Published with the permission of the Surgeon General, United States Army, who is not responsible for any opinion expressed or conclusion reached herein.

[2] This patient was admitted to Tripler United States Army General Hospital in Honolulu as an emergency and transferred to the United States Naval Hospital, Pearl Harbor, six days later, when his condition warranted removal.

was from above, downward, and slightly backward. The splinters were 2 centimeters and 1 centimeter in diameter, respectively, at their points of exit from the skin and tapered to irregular extremities. They appeared to be firmly embedded in the soft tissues of the posterior part of the neck for at least 10 centimeters. There was a ragged punctured wound 4 centimeters long in the skin over the superior carotid triangle of the left side of the neck, from which

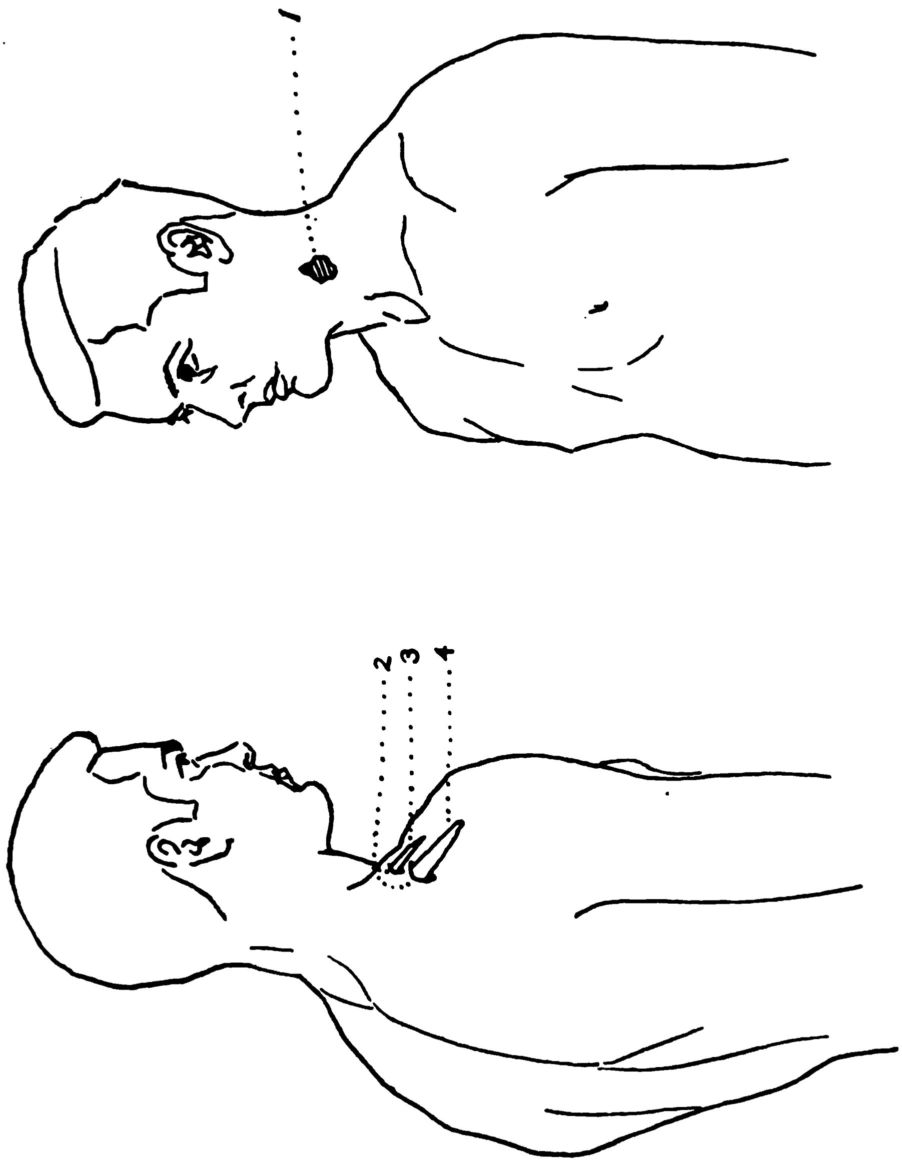


Fig. 1.—Schematic drawing of transfixion wound of neck, incurred in automobile crash. The splinters removed are shown in Figure 2. 1, wound of entrance. 2, wounds of exit. 3, small splinter, 4 cm., showing. 4, large splinter, 8 cm., showing

blood was slowly oozing. (See fig. 1, which is schematic.) There was no bleeding from the mouth or nose nor any evidence of injury to the larynx. Aside from minor abrasions of the face and hands there were no other wounds.

The patient was moderately shocked and complained of severe pain in the neck. The head was fixed in a position of partial flexion, with rotation to the right.

Under gas-oxygen the splinters were safely removed, but with considerable difficulty, due to the firmness with which they were held in the tissues. Con-

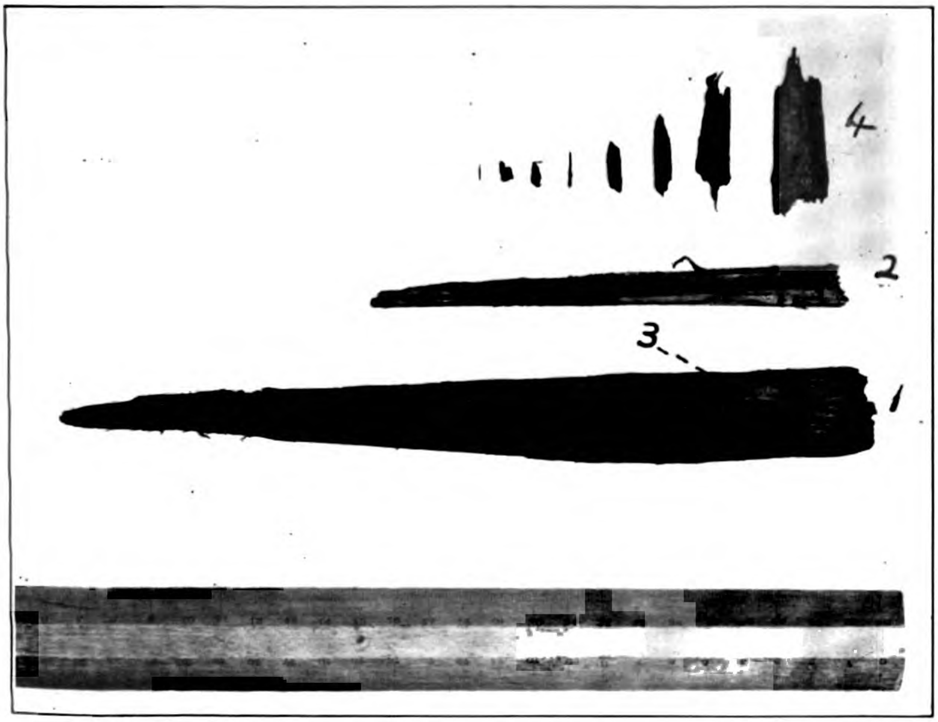


Fig. 2.—Pine splinter foreign bodies removed from soft tissues of neck, following transfixion wound incurred in automobile crash. 1 and 2, Large splinters; 3, point of detachment of small splinter from large one; 4, small wooden particles. (Photograph by Signal Corps, U. S. Army)

trary to expectation, there was no hemorrhage following extraction of the splinters.

The foreign bodies were two pine splinters, roughly conical in shape, tapering to blunt points. The larger one was 24 centimeters long and 3 centimeters in diameter at the big end; the smaller one 13 centimeters long and 1 centimeter wide at the larger end. The small splinter was evidently derived from the larger one, as were numerous smaller wooden particles which were removed when the tract was cleaned out. (See fig. 2.)

The wounds of exit had to be enlarged to remove the splinters; all wounds were debrided and the entire tract dakinized. In spite of a low-grade infection, the wounds healed kindly, and the sailor was out of the hospital 12 days after the injury.

### COMMENT

There are several interesting features of this case aside from the unusual nature of the trauma.

1. The difficulty experienced in extracting the foreign bodies was not only due to the firmness with which they were embedded but more especially to their irregularly conical shape. This fact was not fully appreciated in the beginning, and a great deal of tractive force had to be exerted to pull the splinters out, small end first. It necessitated enlarging the wounds of exit. Had this patient been placed on his back instead of prone it is possible that a much smaller amount of force, exerted as pressure in the line of the tract, would have dislodged the splinters more easily. Traction on the larger ends of the splinters was impossible, as they were buried in the wound on the left side of the neck. Besides, the shape of the foreign bodies was not realized till after their removal.

2. The course of the foreign body, since it was originally one which splintered in the tissues into two large and many small pieces, is worth comment. It illustrates the elasticity of the soft tissues of the neck which permits important structures, vessels, and nerves to slide out of the way of a blunt penetrating instrument, and so escape serious damage. The wound of entrance in the skin of the left side of the neck was over the superior carotid triangle at the level of the upper border of the thyroid cartilage; the larger wound of exit was in the occipital triangle of the right side, 1 centimeter above the acromion. A direct line between these two points traverses the carotid packet of vessels and nerve, the bodies of two cervical vertebræ, the vertebral canal, and the deep muscles of the right side of the neck. Obviously, this was not the course the splinter pursued. The sailor was impaled on the foreign body when his car went through the fence, the line of force being from above, downward, and slightly backward. The patient's body struck the picket at an acute angle, and a large splinter transfixed the tissues, being broken off short in the tissues at one end. The resiliency of the soft tissues gave pos-

teriorly at first; then the sternomastoid was perforated near its posterior border, just missing the external jugular vein. The subsequent course can be conjectured as follows: Through the middle scalene, *levator anguli scapuli*, *longissimus cervicis*, *complexus*, and *multifidus spinæ*, where the splinter struck the bone of a cervical spine and was shivered into two large pieces and many small fragments. The direction of the two splinters was changed slightly backward by this point of resistance; they passed under the *ligamentum nuchae*, through the *multifidus spinæ*, the *complexus*, the *splenius*, and the anterior border of the *trapezius*, to emerge on the right side.

3. The rapidity of healing is remarkable when the amount of trauma is considered. Except for a slight pharyngitis and tonsillitis, which cleared up in 48 hours, there were no complications.

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## DEATH FOLLOWING EXTRACTION OF TEETH[1]

### REPORT OF CASE

By CLIFFORD E. HENRY, Commander, M. C., V. (S.), United States Naval Reserve

Extraction of teeth is generally considered a minor operation, in which the patient is taking little if any risk as to life. With the more extensive reporting of cases and the sequelæ that often follow extraction, the profession is being impressed with the fact that extraction can not be made with impunity, and the liberation of large amounts of toxic material into the system is hazardous. The eradication of dental infection is often imperative, but the teeth should not be extracted if the infection can be otherwise removed.

The object of this paper is not, however, to discuss the technic of extraction, but to report a case of extraction following which there was unusual abscess formation and death.

### CASE REPORT

The patient was first seen on September 22, 1927. A man, aged 51, giving the following history: For the past six months he has been feeling exceedingly well and has been doing considerable walking. He has lost weight during this time, about 50 pounds, which he attributed to the walking. Had pneumonia in January, 1923; no other severe illness. Has had a chronic sinusitis and nasal catarrh for years. Two weeks ago he had some pain in the region of apex of right scapula. At about the same time he had an attack of chills, fever, and sweating. He went to see a dentist, who opened an abscess on the left side of the lower jaw. On the night of September 17 another abscess was opened in the same region. The morning of September 22 he had two teeth extracted and additional drainage. In the afternoon he came to my office for the first time. Pulse 80, temperature 99. There were no lesions in the lungs

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[1] Received for publication Feb. 1, 1928.

and no indications of heart involvement. On October 9 I was called out to see the patient. The right eye was swollen shut, the conjunctiva rolled out as two bags of fluid, the patient was partly delirious, temperature 103, pulse 140. He was hospitalized with a working diagnosis of septicemia with possible lateral sinus infection. On October 13 there was apparently pus in the right region of right orbit and an incision was made through the upper eyelid and a probe passed above the eyeball into the orbit, opening an abscess containing about 4 fluid drams of heavy yellow pus. With a fine silver probe, no opening could be found into either the ethmoidal or frontal sinuses. The immediate cause of death was meningitis. Dr. G. L. Doxey saw the case in consultation and was of the opinion there was a cavernous sinus infection.

Roentgenograms made at the hospital and also by Doctors Griffith and Holliday, exodontists, to whom the patient was eventually referred, showed an osteomylitic condition of the left side of lower jaw. Blood culture was negative. The pus from the orbit contained pneumococci and streptococci. An autopsy was not obtained.

The unusual feature in this case was the abscess in the orbit. That the teeth are frequently the site of infection that is the cause of iritis and other diseases of the eye is a well-known fact.

C. Fromaget points out that dental infection may be carried by the blood stream to the eye where it forms a focus of infection. According to Rosenow the infection is induced chiefly by the *Streptoccus viridans*, which seems to have an elective affinity for the eye.

R. C. Buckley reports a somewhat similar case in which a necropsy was obtained. There was acute maxillary sinusitis; extension of the infection along the right maxillary nerve to the right semilunar ganglion, extra-dural space, and tissues about hypophysis and left orbit; fibrinopurulent meningitis; and abscess of right temporal lobe of the brain.

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# PROSTATECTOMY[1]

By Winfield Scott Pugh, Commander, Medical Corps, United States Navy (retired)

Just as we were about to enter the ampitheater one of the nurses, seeing our cases grouped, asked us what percentage of men develop prostatic disease? We replied as follows: The two most important lesions of this organ are chronic prostatitis and prostatic hypertrophy. The former very few of us escape. Practically every man

[1] Clinical lecture delivered at Parkview Hospital, New York City, Dec. 7, 1927, under the auspices of the Steinburg Foundation.

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who has had gonorrhea at some time suffers prostatitis. Therefore, the great armies of the past and present sink into insignificance when compared to the hosts of this disease. To-day we are interested in the prostatic lesion known as hypertrophy. While by no means as common as prostatitis it is relatively frequent. Among the standard textbooks one sees hypertrophy as occurring in 20 to 25 per cent of the males over 60. Certainly that is a modest estimate, as in our experience the incidence is about 33⅓ per cent.

Do we see most of those who have prostatic enlargement? Certainly we do not. Most of the patients calling on the medical advisor are found well advanced in the disease. It is also a fact that many with quite pronounced lesions do not manifest symptoms of moment. The actual incidence of this entity must therefore even considerably exceed our estimate.

What is prostatic hypertrophy? I regret my inability to give a practical answer to this question. It is still the subject of much discussion, some contending that it is of inflammatory origin, i. e., a definite hyperplasia. The other school believes it to be a typically adenomatous development.

Ciechanowski, after a large amount of research work, wrote a lengthy article advancing the inflammatory theory, particularly emphasizing the part played by gonorrhea. This author believed that a long continued chronic inflammation was the basis of the changes which take place in hypertrophy of the prostate. He believes the adenomata that are sometimes seen have nothing to do with the real prostatic hypertrophy.

Billroth believed it to be a definite hyperplasia of inflammatory origin.

Cohnheim believes we are dealing with a definite tumor formation.

The French school, comprising such well known names as Albarran, Chevasau, Marion, and Socin, hold the theory of true tumor formation.

Among the more recent studies we find Adami and Nichols holding to the inflammatory idea, with the adenomas as incidental.

Aschoff, in his pathologic anatomy, is converted to a true tumor formation.

We have learned one great point of interest, and that is we have never found a definite prostatic hypertrophy in a cadaver. This is based on almost 1,000 bodies past 50 years of age examined in the dissecting rooms of the medical schools in New York City. Our interest in this was stimulated while first studying prostatectomy. The attendant of many years service remarked at the time, "Doctor, they don't seem to be able to do that operation very well on cadavers."

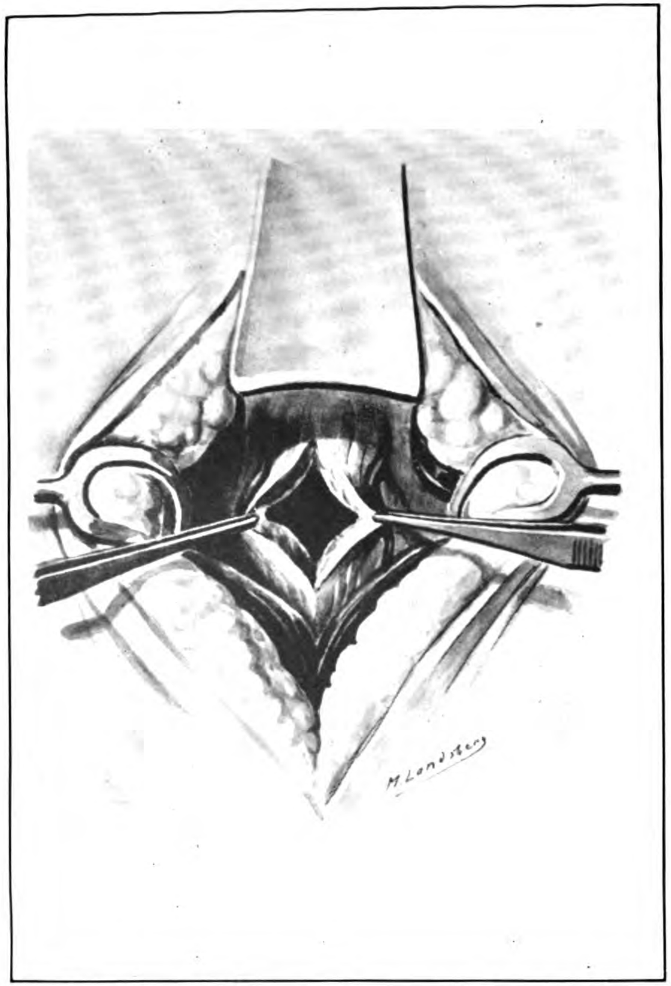


Fig. 1.—High suprapubic cystotomy opening ready for drainage after prostatectomy

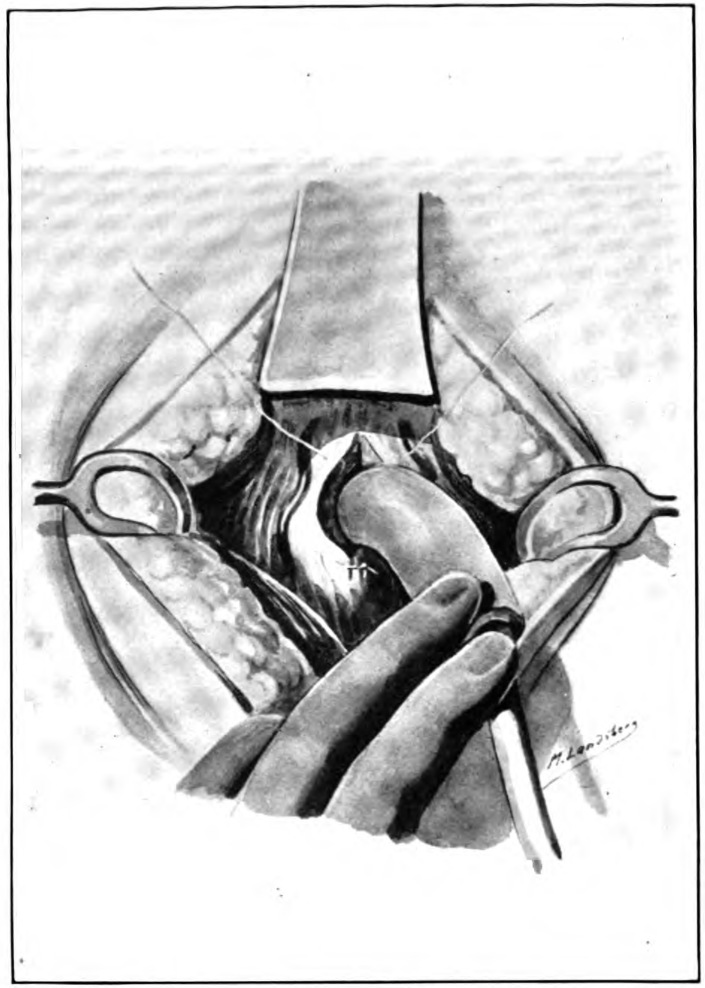


Fig. 2.—Insertion of the Kenyon tube

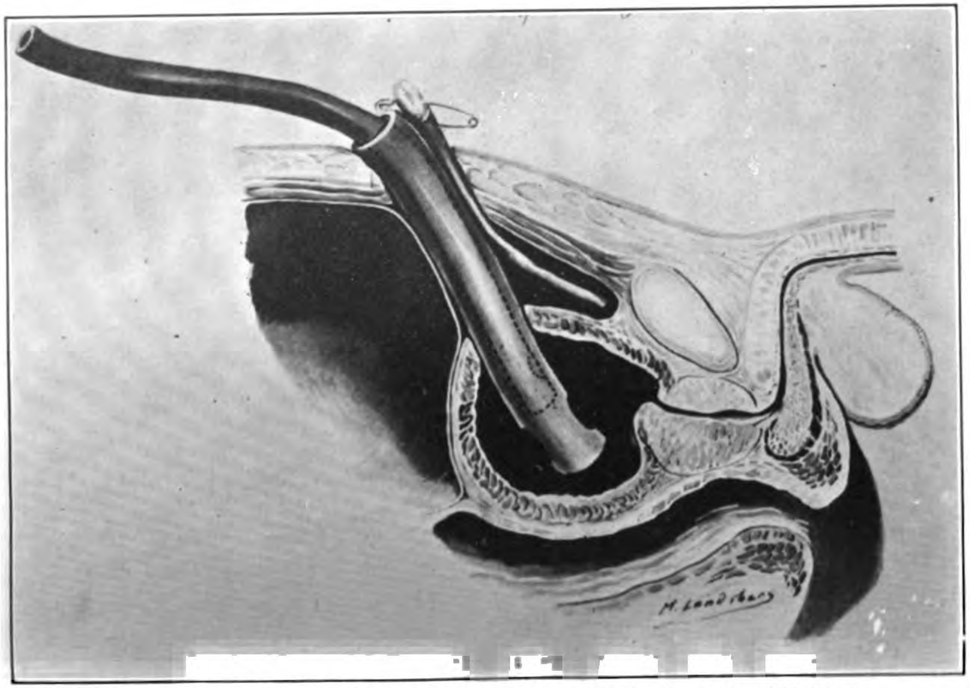

Fig. 3.—Showing position of bladder drain and wick in space of Retzius

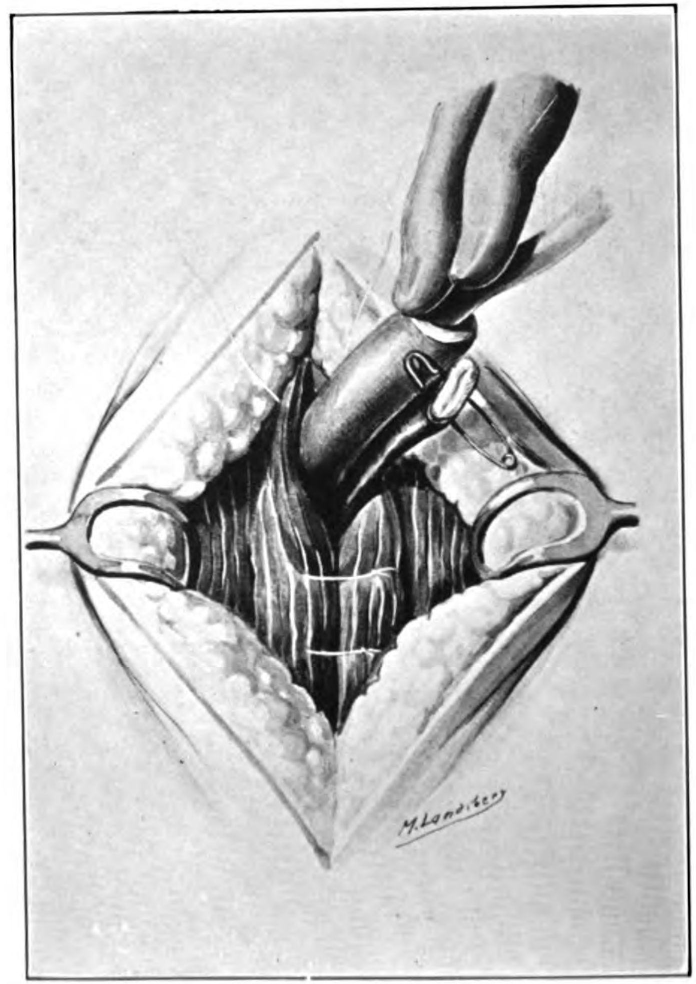

Fig. 4.—Closing of muscle around drains

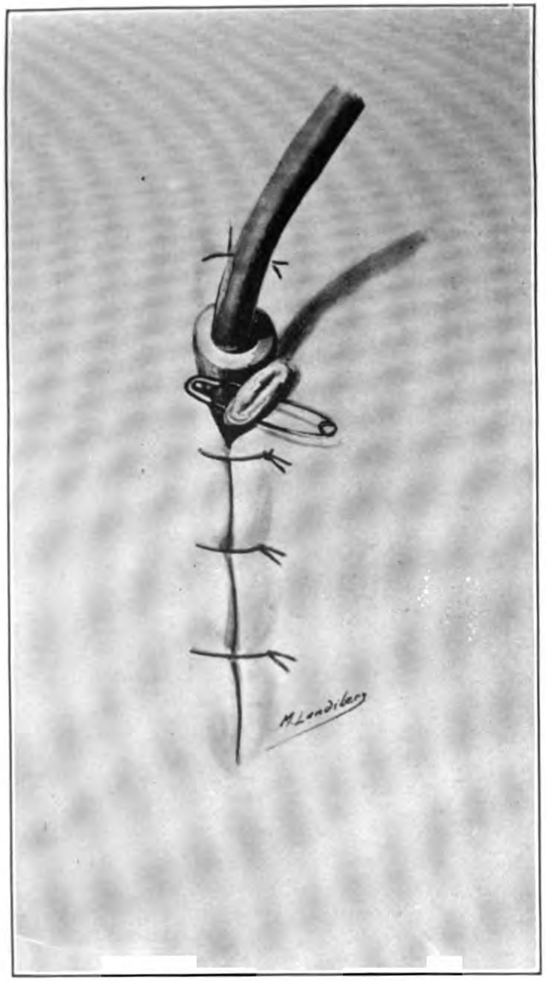

Fig. 5.—Closure of skin and fascia

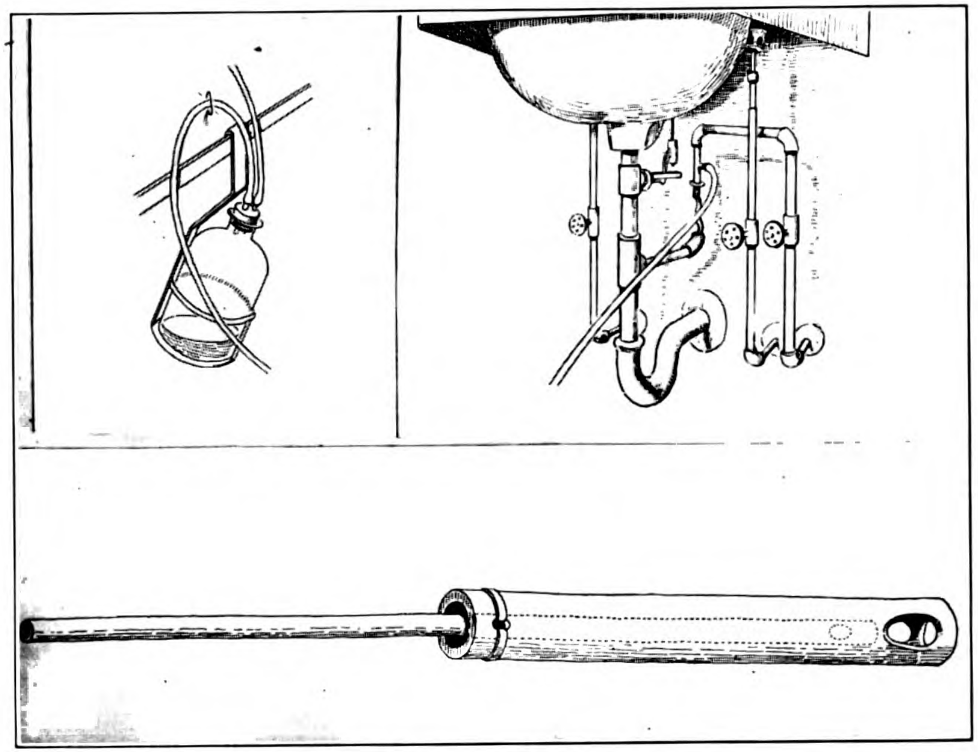

Fig. 6.—Wash bottle for connecting tube to patient with drain. The Chapman pump connected with sink suction. The Kenyon tube in detail

His observation was correct and on following it up we recorded the findings just noted.

Much difference of opinion prevails as to the original focus of the hypertrophy. It would seem to us, however, that the initial development may occur in any part of the gland, but most commonly in the lateral lobes. Cabot tells us that the functional demand has its influence upon the stimulation of the cells to take on growth characteristics. He believes this is borne out by the facts that enlargement occurs usually just past middle life. Gardner makes the observation that hypertrophy of the prostate is rarely if ever observed in Catholic priests. Having seen several among the clergy ourselves, that argument is open to question.

The pathology of true prostatic hypertrophy must be distinctly separated from that of other vesical neck obstructions. In this group one must include the subcervical and subtrigonal hypertrophies; the prostatic bars and rings. These differences must be recognized, as failure to do so has caused much suffering to the patient and embarrassment to the surgeon. Only recently we saw a prostatic hypertrophy, so called, in consultation. The surgeon had subjected the patient to a suprapubic cystotomy but was unable, as he said, to eradicate the prostate. There, presented to view, was a typical prostatic bar—sans prostate. A punch introduced suprapubically cleared the obstruction and the patient of symptoms.

A discussion of the methods used in separating the different entities causing obstruction of the vesical neck is most interesting. The same applies to that most important subject, preliminary preparation. Indeed, this latter is of greater import than the operative procedure. However, as we have been allotted the subject of operative procedure, it is incumbent on us after these few introductory remarks to proceed with it as our main topic.

### METHODS OF PROCEDURE

Everything being in readiness, what procedure will we carry out? The doctor has asked us if we do a suprapubic or a perineal prostatectomy. Our experience in the practice of surgery convinces us that one should follow no set dogmas. We regard it as a great misfortune that some of our master minds can see only one line of procedure. Really this is sad. There are unquestionably definite indications for both types of prostatectomy. We also believe conditions may arise in which a combined procedure will be most advantageous. Certainly this is applicable in prostatic carcinoma. If we believe both methods are good, how will we arrive at our conclusions as to what shall be done in the cases at hand?

As a rule we find that where our prostate projects well up into the bladder and to but a moderate degree into the rectum, suprapubic removal is the method of choice. Where the gland seems very low, dipping well down into the perineum and rectum, the perineal route is ideal. There is little doubt, however, but that the lower route requires more skill and experience. We should hesitate to recommend it to the beginner.

The two cases we have with us to-day are of the high type with large lobes projecting well into the bladder. We shall attempt a one-stage prostatectomy in both cases. What do we mean by a one-stage procedure? As you know, it is customary in most clinics to drain the bladder until the patient is in condition to remove the gland. Some men drain suprapubically preliminary to a perineal prostatectomy. This latter we feel is hardly justifiable. Most of those who drain the bladder by a cystotomy do not believe drainage can be accomplished in any other way. In our experience it is practicable to drain 90 per cent of these cases via urethra with an indwelling catheter. Both of these men have been so drained for about 10 days with very little discomfort. The opponents of urethral drainage will tell you: "Be careful or your patient will develop an epididymitis." Quite so—this is a possibility, but in about the same proportion as those drained suprapubically. As a rule we ligate the vas subcutaneously before we insert the urethral catheter. This is advisable as a preliminary in all prostatectomies. More or less injury of the seminal ducts is bound to take place on removal of the prostate, even in the hands of the most skilled surgeons. Seminal vesiculitis and epididymitis follow in its wake. If these attacks only occurred once it would not be so bad, but they have a habit of recurring, much to the annoyance of the patient.

Vasoligation is a simple little procedure and quickly done. As we are scheduled to discuss it again later we will not burden you to-day. A very excellent article regarding technic of vasoligation by Alyea has just appeared. It is better than anything we might say.

As we are carrying out a series of observations on anesthesia technics we are doing some operations by abdominal block and others by spinal anesthesia. Our operations to-day will be under the latter method.

### THE ANESTHESIA

Do not think that because you have seen our friend Doctor Labat enter the subarachnoid space with apparent ease, that it is a simple procedure. No one has been able to convince me that puncturing the spinal canal should be taken lightly. Have your patient well pre-

pared and seat him on the edge of the table, head and shoulders bent well forward. We will then search for the spinous process of the third lumbar vertebra. Just beneath this landmark we insert our needle. What kind of a needle should one employ for this purpose? The needles used by different operators vary from 19 to 22 gauge and from 3 to 4 inches in length. We use an American made syringe of the Luer Lok type with a 22-gauge and 3-inch length. As you will notice, our needles are made of nickeloid, a substance which will not rust. When one enters such a canal as the subarachnoid space it ill behooves the operator to inject rust with his anesthetic. A 10 c. c. syringe is used for injection purposes. You will note that we are using a very convenient little ampule which contains about 10 centigrams of novocaine or its equivalent. We now break the neck of the ampule. Our spinal needle having been introduced, we remove the stylet and, as you see, fluid at once appears. This is allowed to flow into the ampule drop by drop until it is almost filled. There is now in the ampule about 5 c. c. of the spinal fluid, in which the novocaine is dissolving. When completely dissolved this fluid is taken up in the syringe and injected very slowly into the needle that has penetrated the subarachnoid space. Our needle is then quickly withdrawn and the patient placed on his back. The doctor asks if we do not practice barbittage? No; we do not. This method consists in the withdrawal and reinjection of spinal fluid after the original novocainization. It has always seemed to us an unnecessary procedure and as you will note our anesthasia, though of simple technique, is quite adequate. Analgesia appears almost at once and we will in a short time have complete abolition of sensation from the nipple line to the toes.

Spinal anesthesia is not free from danger, neither is any other form of sensory abolition. One must be constantly on the watch for evidence of falling blood pressure. You will note that our table is so arranged that the patient can be quickly swung into a Trendelenburg posture. When the blood pressure begins to slip, the patient should be placed in this position and given caffeine-sodium benzoate at once. In patients with low pressure it is also advisable to administer the anesthetic in the Trendelenburg position.

### SUPRAPUBIC PROSTATECTOMY

Our patient having had about 200 c. c. of boric-acid solution injected into the bladder, via urethra, he is placed in a moderate Trendelenburg posture. An incision is now made slightly to the right of the median line from the symphysis pubis to about 3 inches below the umbilicus. It is important that our incision be well down over the pubic joint, but not into it. Failure to observe this precau-

tion often means the development of an arthritis at this articulation and months of invaliding for the patient. Why do we not enter the midline of the abdomen? Yes; it is a little easier to do that, but experience has taught us we get better results by our procedure. After we have made our cutaneous incision it is carried down through the fascia to the muscle aponeurosis. This latter tissue is then incised and the muscle fibers separated. Now you are beginning to see why we use the lateral approach, as beneath the rectus we again separate the fascia. Our muscle opening is slightly extended with the handle of the scalpel and we are down on the peritoneum close to the pubes.

In this patient the peritoneum is attached very low, almost to the pubes, and we could easily injure it. We run our hand over the peritoneum and retract this structure from its reflection over the bladder. In this case it is rather thick and retracts easily. As you notice, we are pulling back the peritoneum over the dome of the bladder. Now the veins of the bladder are seen running vertically on its rounded surface. We are certain, therefore, that this is the urinary viscus. Some one has asked, softly, why does he retract the peritoneum so far? Well, my friends, the answer is this, so that we can plant our tube as high as possible in the bladder. This promotes healing and is a good prophylactic of a persistent fistula. I assure you these sinuses are most embarrassing to the surgeon and very annoying to the patient. With a silk retention suture passed through the bladder on each side we incise the organ between the threads. As the fluid flows out we lower our patient and insert the right hand into the bladder. The index finger passes down between the large lobes of the prostate and into the urethra. While we do this an assistant has passed his index finger into the rectum and lifts up the prostate as high as he can. Would it not be advisable to place our own opposite hand or finger in the rectum? Some do that, it is true, but to us it is inadvisable. Why? Because we have repeatedly seen experienced operators take that finger out of the rectum and put it in the abdomen. We are human, as are all others, and refuse to take a chance.

We are now all set for the prostatectomy. Our right index finger is pressed forward into the urethra and the anterior commissure of the prostate is ruptured. When this happens you will notice a projection sticking up against your finger. Just beneath this mass a sluiceway is plainly discernible. Place your index finger in this gutter and follow it all the way around until you have the entire adenoma or prostatic mass in your right hand. Then gently remove it, severing any remaining attachments with the fingers. I admit all this sounds much easier than it really is. Sometimes the mass is very adherent, and quite a little patience must be exercised in

its enucleation. This mass, as you notice, has not presented much difficulty. Following the removal of the mass it seems as if a well of blood were flowing over. Many excellent devices have been introduced to check this bleeding, such as the Pilcher and Davis bags. As a rule the oozing quickly stops on firm packing. This case bleeds a little more than usual and we shall pack him and leave the gauze projecting from the abdominal wound. We now insert a Kenyon tube in the upper angle of the bladder and close the viscus with continuous suture of chromic gut well up to the tube and gauze drain. We then place a small cigarette drain in the space of Retzius, removing it in 48 hours.

The abdominal wound is closed in layers with catgut and the skin with silkworm gut. We now connect our drainage tube to the pump you see in the picture here drawn (Fig. 6). This keeps

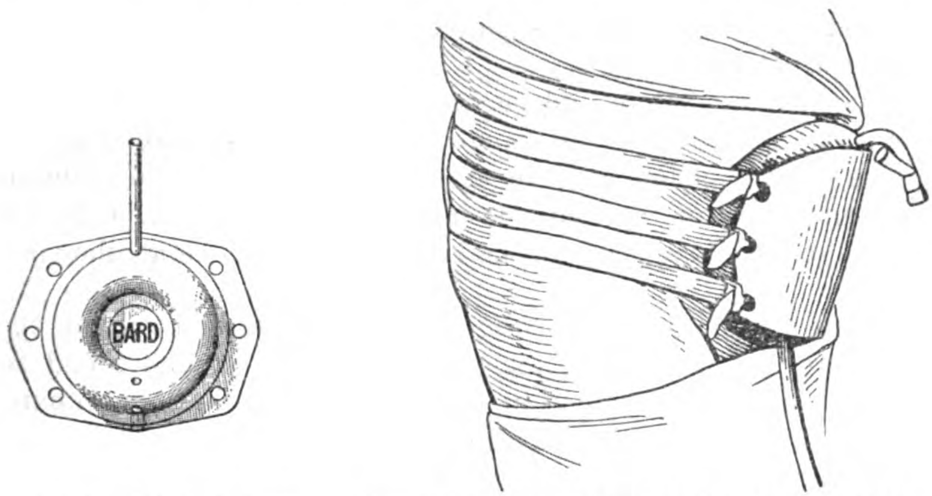


FIG. 7.—The Kinney pneumatic suprapubic cup and lateral view of cup applied

the wound nice and dry and promotes healing. The packing will be removed to-morrow and the tube in about 5 days. Following this we apply the Kinney cup, which allows drainage but keeps the clothing dry. Where suction drainage is not available these cups are indispensable. The abdominal wound should be entirely closed in three weeks. How soon will this patient be out of bed? He will be propped up to-morrow and out in a chair within a week.

We have had to move rather quickly to-day as our time is limited and we must go on with the other case. It will be a repetition of what you have just seen, but see it.

What of the postoperative treatment?

#### POSTOPERATIVE TREATMENT

The care of the prostatic is very similar to child handling. Many of them are well advanced in years and withstand surgical attacks

none too well. The patient is taken from the operating room well wrapped in blankets and placed in a good warm bed, with everything possible done to maintain his blood pressure. As we have said before, the patient should leave the operating room with the bleeding controlled. This is, however, quite deceiving, and again the hemorrhage may recur. A nurse must be constantly on guard to watch for this possibility. When it appears, and bleeding is excessive, no time should be lost in repacking the prostatic bed. It is much better to pack one needlessly than to lose a patient from hemorrhage. Advocates of the perineal route exclusively tell us they have a great advantage in the ease with which postoperative hemorrhage may be controlled. We wish to state right here that we have seen a number of excellent operators very much disturbed in attempting the perineal control. We believe that our patient should have all the water that he can drink. It not only helps maintain the blood pressure but dilutes the vascular toxins and tends to prevent constipation.

Young tells us that in a large series pneumonia was the most frequent cause of death. This is one reason why we should get our patients up and about as soon as possible. Aside from a definite pneumonic infection, an embolus in the lungs is by no means rare. We have seen it three times in the last three months on another large service.

In these cases, on the morning following operation, slight chest pains were complained of, temperature was 103°, and blood was present to a varying extent in the sputum. A chest examination showed a pulmonary congestion but not the definite consolidation of a pneumonia. Within two days the temperature was normal, and the patient felt greatly improved. Sudden death, however, may occur in this way. We have seen it two weeks after operation.

Uremia was formerly regarded as a frequent and most serious postoperative complication. In this, the era of scientific urology, it is largely prevented by the preoperative treatment. It is the chief reason for the imbibition of large quantities of water that we have mentioned before. If there is any indication of a toxic condition, use water by rectum, subcutaneously, and intravenously with a lavish hand.

Hiccough, I can assure you, gentlemen, is one of the most formidable complications with which we have to deal. How often does it occur? I can not tell you with any degree of accuracy, but certainly often enough. What shall we do about it? We hear of Spts. aetheris comp., the so-called Hoffmann's anoydyne, and the use of cracked ice. Some use amyl nitrite. Really these methods are of very little value. Gastric lavage is often most efficacious. Morphia

should be used liberally, as it will do these patients no harm. Where this does not succeed, inhalations of chloroform may be used. This condition calls for heroic measures, as often our patients are so devitalized they are unable to stand the strain very long.

Abdominal distention with tympanites is very often seen after prostatectomy. Expect it and do not get excited. As a rule, it subsides after the first 48 hours. Local anesthesia has done away with this complication to a considerable extent. By that I mean the distention is not so serious as formerly noted. If it does not disappear after the use of a soapsuds enema, eserine or pituitrin may be used. Avoid the use of Epsom salt in these cases, as it is poison to them.

Infection of the wound: This is very much less frequent where suction drainage is used. Sometimes it occurs in spite of the utmost care. Gangrene and sloughing may even occur. They must be treated by opening and draining the areas involved. Mercurochrome in 1 per cent strength is particularly efficacious in this instance. Dakin's solution is also of value. Epididymitis should be avoided, as we told you earlier in the afternoon. Where a persistent abdominal fistula occurs after operation, some obstructive mass has usually been left; look for and eradicate it.

When shall we pass an urethal sound? Some say never, but never seems like a long time. We usually recommend the passage of a large sound in about two weeks.

In our little talk to-day we have tried to touch on the most important points in relation to suprapubic prostatectomy. Only too well do we realize that it is a big subject and we have only scratched the surface. The drawings which we present are well done and interesting. This, together with the bibliography appended, will make up for any omissions on the part of the speaker. A perusal of this list will well repay anyone interested.

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## MODERN METHODS OF TREATMENT OF BRONCHIAL ASTHMA[1]

### A Review

By S. A. Parowski, Lieutenant (Junior Grade), Medical Corps, United States Navy

The subject of bronchial asthma has received very much attention in old and modern literature. Many opinions have been put forth as to the true nature of this disease, especially regarding the pathology, the factors of causation, and the treatment.

Although modern writers agree on the pathology wrought in the lungs and admit most of the factors of causation, they differ greatly when it comes to the mode of treatment that ought to be instituted

[1] From U. S. Naval Hospital, Chelsea, Mass.

in a condition of bronchial asthma. This divergence of opinion as to the treatment is a manifestation of the fact that so far no specific treatment of a curative nature has been found.

The numerous factors of causation point to the improbability of finding a cure for all cases. A cure of this kind would have to consist of something that would so fortify the human organism as to enable it to hold its own regardless of the many causative factors to which it may be exposed.

So far, the only logical treatment is one based on the etiological study of each individual case. What may be considered a satisfactory treatment in one case may be very unsatisfactory in another case and vice versa.

It is my aim to review some of the modern methods of treatment that have been brought out and give their methods of administration.

Under the heading of treatment we have to consider treatment of the so-called " bronchial attacks," treatment aimed at the prevention of these attacks, and treatment intended as a cure for asthma.

1. *During attacks.*—Nothing has proved of greater value than epinephrin given by mouth, or better still, hypodermically. The usual dose is m. V to m. XV. Atropin hypodermically, gr. 1/100, is also used with great success. Some doctors employ morphine, which is bad procedure because it invariably leads to the formation of the "dope" habit. Pituitrin, hypodermically (1 ampule), is used in the same way as epinephrin and atropin. Calcium therapy in single large doses is now used by some for the rapid removal of actual attacks. Various substances are used by way of inhalation, such as amyl nitrite, chloroform, stramonium leaves, burnt together with nitrate of potash, and potassium nitrate.

2. *To prevent attacks.*—Injections of epinephrin over long periods of time have aided in warding off attacks. Calcium chloride injections given intravenously, or calcium lactate, together with parathyroid extract administered orally, are being substituted for the older method of epinephrin injections.

3. *Curative treatment.*—The modern methods of treatment intended as a cure for asthma are varied and to a large extent unsatisfactory. The finding of the exciting agent in the case of asthma due to anaphylaxis and the desensitization of an individual against such exciting agent is a very logical method of treatment. Unfortunately desensitization can not be accomplished in all cases even when the sources of effective allergens are known. In such cases a change of location or the removal of the offending substance often results in a cure.

Sensitization to dusts of various kinds was shown by Kern, Meyer, and others to be a great factor in the production of asthma. Removal

of such dust or desensitization treatments prove beneficial in many cases.

Infection is also considered a great factor. Foci of infection ought to be looked for and removed. Koopman, Helsman, and Golltich found streptococci in the sputum of many asthmatics, and vaccine made from such sputum cultures proved of great value. Rackemann, Graham, Rouse, Thomas, and Touart use autogenous vaccines in cases where there are no specific reactions to foreign proteins, no foci of infection, and no irregularities in diet or mode of living. They report very good results.

Arjeff, Civallier, and Stube report their experience with tuberculin injections. Only those cases get better in which tuberculosis is the underlying cause.

Aulde describes his peptone treatment, in which he uses Armour peptone intravenously (dose 0.3 c. c., increasing by 0.2 c. c. up to 1.5 c. c. of 5 per cent sol. in normal saline) or intramuscularly (dose 7.5). Such injections should be given slowly. Milk injections, also combined peptone and vaccine, have been tried with success.

Of late, calcium therapy is being employed in the treatment of asthma. Some administer the calcium on the basis that there exists a deficiency in the calcium content of the blood. Whether such a deficiency is the causative factor, or is only secondary or even accidental, we do not know. We do know, however, that a correction of such a deficiency results oftentimes in permanent cures, or at least in a betterment of the patient's condition. Others use calcium on the grounds that bronchial spasms are caused by a hyperstimulation of the pulmonary branches of the vagus, as shown by experiments on animals proving that calcium inhibits the parasympathetic system, of which the pulmonary vagus is a part.

Calcium bromide is used in doses of 0.5 to 2 gm. in 5 to 20 c. c. of normal saline solution, given by slow injection. Calcium chloride is also used in increasing doses of 5 c. c. to 10 c. c. of a 5 per cent solution at 5 to 7 day intervals, or even daily in doses of 0.5 to 1 gm., until 10 or more injections are given.

Naval, Hollender, Brown, Hunter, etc., give calcium lactate gr. V, t. i. d., together with parathyroid 1/20 gr., t. i. d., or thyroid 1/10 gr., t. i. d. Their results have been very promising, especially in cases where a calcium deficiency has been demonstrated. This method of calcium and parathyroid administration has been used on five of our asthmatic patients and two hay-fever cases at the United States Naval Hospital, Chelsea, Mass., and all have been helped to a greater or lesser degree.

Kummell, Jungmann, and Browning report on the removal of the cervical sympathetic and its ganglia. So far there is a difference of opinion as to the advisability of such an operation.

Klemitz and Guarini have introduced X ray as a method of treatment. Many favorable reports have appeared in the literature. Guarini advises that the rays be filtered through a zinc filter 0.5 mm. thick and the whole thoracic region irradiated. He further advises that the treatment be continued for three weeks with four treatments per week.

### CONCLUSION

The methods of treatment outlined above have resulted in many cures. What may be a cure in one case may be totally ineffective in another. So far no specific treatment has been found for all cases. The best methods of treatment are those based on the etiological study of each individual case.

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## DIFFERENTIAL DIAGNOSIS IN A CASE OF POLYURIA [1]

By G. W. Smith, Lieutenant (Junior Grade), Medical Corps, United States Navy

D. T., sea., 2c., age 20, entered this hospital September 2, 1926, complaining of frequent urination and an excessive thirst.

*Family history.*—Patient's mother is living and well. One sister, age 18, has tuberculosis and is in a sanitarium receiving treatment. Two brothers, age 7 and 14, have polyuria and enuresis. Two sisters living and well. One sister dead, age 19, cause unknown.

*Past history.*—Patient gives history of having the usual childhood diseases. Has always been strong and healthy and has a very good health record. There is no history of previous operations or injuries.

Patient has headaches occasionally, but they are not severe. Vision is good and there is no history of trouble with his ears.

No history of tonsillitis, frequent head colds, or attacks of sore throat.

Patient has had no respiratory diseases, no chronic cough, night sweats, afternoon fevers, or a loss of weight.

No history of constipation; eats any type of food equally well. Normal appetite. No record of abdominal distress, nausea, or vomiting.

Venereal history negative.

Patient has had no swelling of his hands, feet, or infraorbital edema.

*Present condition.*—Physical examination reveals a well nourished young man about 18 years of age. His complexion is rather anemic.

Height, 5 feet 7 inches. Present weight, 146 pounds. Normal weight, 146 pounds. Temperature, 98.6; pulse, 70; respiration, 20. Systolic blood pressure, 100. Diastolic blood pressure, 62 mm. Hg.

There are no scars or other evidence of cranial injuries. Eyes normal; pupils reacting equally to light and in accommodation. Tonsils slightly hypertrophied but not clinically diseased. Slight anterior cervical adenopathy present.

Chest shows a normal expansion. Lung clear and negative to physical examination.

Heart is normal in size, no murmurs or abnormalities.

Abdomen negative.

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[1] From U. S. Naval Hospital, New York, N. Y.

Genitalia negative.

Extremities negative.

Reflexes normal.

*Laboratory findings and special examinations.*—Blood count: Leucocytes, 10,200; hemoglobin, 95 per cent; neutrophiles, 68 per cent; lymphocytes, 28 per cent; eosinophiles, 2 per cent.

Twenty-four-hour specimen of urine: Amount, 4,000 c. c.; Sp. gravity, 1.011; albumin, negative. Acid reaction. Pale amber in color. Negative for acetone and diacetic acid. Microscopical examination, normal. There is an occasional trace of albumin but no casts in the urine. Total chlorides and total nitrogen content per 24-hour urinary specimen averages about 16 and 12 grams, respectively.

Blood Wassermann, negative.

Blood chemistry: N. P. N., 35 milligrams; urea N., 16 milligrams; uric acid, 3.2 milligrams; sugar, 103 milligrams; creatinine, 1.1 milligrams.

Phenolsulphonephthalein kidney function test: First hour, 50 c. c., 40 per cent; second hour, 180 c. c., 15 per cent; total, 55 per cent.

X-ray report of patient's head by Doctor Perry: Examination of the sella turcica shows relations of same to be normal with no evidence of pituitary tumor or calcification.

Glucose tolerance test: Normal. 8 a. m., 97 milligrams sugar. (Blood); 8.15 a. m., 105 milligrams; 8.45 a. m., 137 milligrams; 9.15 a. m., 88.2 milligrams; 10.15 a. m., 81.4 milligrams; 11.15 a. m., 77 milligrams.

Eye examination by Doctor Albright shows patient's field of vision to be within normal limits. Eye grounds are clinically negative.

*Progress notes.*—Patient admitted and put on a soft diet. Fluids have been restricted as much as possible. They average about 2,400 c. c. intake per 24 hours. Urine output averages about 3,500 c. c. per 24 hours. About two weeks after his admittance, patient received 1 c. c. of pituitrin intramuscularly per day.

Patient has gained 10 pounds in weight during the last six weeks. Patient was to have a spinal puncture but disappeared the evening prior to the procedure.

### DIFFERENTIAL DIAGNOSIS

Various conditions will cause polyuria. A temporary polyuria is common, and may be due to some emotional strain or excessive intake of fluids, but when a polyuria exists over a month or several months, it is most likely organic in nature. Various conditions will cause persistent polyuria.

Polyuria is very often associated with chorea. However, in this case it is evident from the physical findings and history that this patient does not present the picture of chorea, which usually occurs around the age of from 9 to 16 years and is comparatively easy to recognize.

There is usually a polyuria present in pyelitis. However, this can easily be ruled out by the absence of chill, pain, fever, and associated symptoms, and by the absence of the characteristic urinary picture, the presence of pus, an acid urine, and a characteristic sediment containing casts and renal and pelvic epithelium.

Amyloid kidney is usually diagnosed by autopsy and its presence in most cases is never suspected. Moreover, amyloid kidney is characterized by some chronic condition, for example, chronic suppuration, chronic ulcer, active tuberculosis, etc. Also there is present a combination of polyuria, low specific gravity, and a large albumin content in a patient showing amyloid changes in the spleen and liver.

In chronic interstitial nephritis the onset is usually insidious. In the early stages of this condition the patient may appear to enjoy unusually good health, this being particularly true in the sthenic type. Pallor, edema, and pigmentation are late symptoms, and the urinary findings are sometimes both variable and obscure. Many cases of chronic interstitial nephritis die under other diagnoses and, in the case of many others, recognition is deferred till autopsy.

Chronic interstitial nephritis is characterized by an increased blood pressure. Edema, if present, is usually due to failure of circulatory compensation. Characteristic changes in the fundus oculi is present as a rule. The essential urinary findings in a typical case consist in the increase in the amount of night urine, attended by increased frequency of micturition, and a total increase for the 24-hour specimen; a more or less persistent and extreme tendency to diminution in the total amount of solids, traces of albumin, and a few hyaline and granular casts.

From the patient's age, physical findings, and laboratory findings, including his normal phenolsulphonephthalein output, it is evident that we can eliminate chronic interstitial nephritis.

Polyuria due to the absorption of exudates is easily eliminated.

Diabetes mellitus is eliminated by the absence of hyperglycemia and glycosuria, and a normal glucose tolerance test.

The question of diabetes insipidus is not so easily eliminated nor is it easy to say that the patient has not diabetes insipidus.

This condition is most common in young persons, about 85 per cent of them being under 20 years of age. The hereditary tendency has been noted in many instances. The etiology is obscure. In general, irritation or injury affecting the base of the brain, in the region of the pituitary gland, may bring about this unusual condition of persistent polyuria. The insufficiency of the function of the pituitary lobe may bring about this condition. However, in not all cases, for in experiments on dogs where the complete pituitary gland was removed polyuria did not necessarily develop. Cushing advancd the suggestion that disturbance of the pituitary function through its autonomic nervous connections may explain the polyuria in functional nervous disturbances.

The disease ususally comes on gradually. The increased secretion of urine, with increased thirst, are the prominent features of the

disease. Cases are on record of 56 pints of urine being passed in 24 hours. The specific gravity is low, 1.001 to 1.009.

Hysterical polyuria may simulate diabetes insipidus closely. This condition, however, is always transitory in nature.

### CONCLUSION

This patient has an average of about 3,500 c. c. of urine output per 24 hours. Normal amount of urine passed is about 1,200 to 1,500 c. c. per 24 hours. The symptoms of polyuria—extreme thirst, urine low in specific gravity, averaging since admittance about 1.008—and the total absence of casts, blood, or pus in the urine, lead us to believe that we were dealing with an obscure condition.

We have probably ruled out the presence of a cerebral tumor involving the base of the brain by the eye findings and subjective symptoms. The past history eliminates injury to the head, which might involve the pituitary gland. There is no neurological evidence of any chronic or acute inflammatory process involving the base of the brain.

The history of the patient's two brothers having polyuria and enuresis leads to the diagnosis of diabetes insipidus, most likely hereditary in type.

It is admitted that in most cases of diabetes insipidus the polyuria ranges above 3,500 c. c., and the specific gravity is usually lower than 1.009. In a large number of cases pituitrin has a definite therapeutic value in relieving the thirst and in reducing the urinary output. However, its absence, or failure to relieve these symptoms, does not exclude the diagnosis of diabetes insipidus.

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## CHOLANGITIS ACUTE WITH FATAL CHOLEMIA

### REPORT OF CASE

By O. B. MORRISON, Lieutenant (Junior Grade), Medical Corps, United States Navy

E. W. A., M. M., 3c., United States Navy, was admitted to the sick list aboard the U. S. S. *Colorado* on November 8, 1927. At the time of admission his only complaint was that the color of his skin was yellow. His temperature was 99, pulse 72, and respiration 20. He stated that he did not feel sick but had reported to the medical officer only because his shipmates had, for the last two or three days, been talking about his yellow color. His family history was negative. He had had an attack of iritis in April, 1925, and had been transferred to the hospital for this condition, which cleared up under treatment. He had a slight attack of bronchitis in July, 1927, and an attack of acute tonsilitis in September, 1927, from which he made an uneventful recovery.

*Venereal history.*—Patient developed a gonococcus infection of the urethra in July, 1926. He received treatment for this condition and made an apparently good recovery. About the 1st of July, 1927, he reported to the sick bay,

complaining of a sore on his penis. On examination this sore was found to be a hard, indurated chancre, and a dark field examination showed *Spirocheta pallida*. Patient was put on antileutic treatment immediately. He received neosalvarsan in the amounts, and on the dates indicated: 0.45 gram, July 14; 0.9 gram, July 28; 0.9 gram, August 3; 0.9 gram, August 18. He received intramuscular injections of mercury in one-sixth grain doses on the following dates: July 20, 25, 27, 30; August 1, 4, 6, 8, 11, 15, 20, 22, 25, and 27. After receiving the last dose of salvarsan on August 18 the patient developed a trace of albumen in his urine and the salvarsan was discontinued. Mercury injections were continued until August 27. A second examination of the urine was made, and, while the amount of albumen was noticeably decreased, there was still a faint trace present. For this reason the patient was advised to suspend all antileutic treatment for the present. A Kahn test on October 18, 1927, was negative.

*Present illness.*—On November 8, 1927, the patient reported to the sick bay complaining of the yellow color of his skin. Physical examination showed that there was an icteric tint to the scleræ and skin, but was otherwise negative. Temperature was 99 and pulse 72. He received treatment for this condition and was put on a liquid diet for two days, after which he was allowed a fat-free diet. The temperature dropped to normal on the day after admission and remained normal until November 14, when he was put on daily administrations of sodium phosphate and allowed to return to duty. At this time the jaundice had markedly decreased and he stated he felt better and able to do duty. He was directed to report to the sick bay at the expiration of a week, or at an earlier date if he did not continue to improve. On the 21st of November he again reported to the sick bay and was found to be very markedly jaundiced. He also stated that the day before he began to feel somewhat dizzy and was slightly nauseated. In addition, he stated that he had no appetite, and for the past five or six hours had suffered with dull pains in the left lower quadrant of his abdomen. He was again put to bed. Nothing was given by mouth. An S. S. enema was given with good results and this relieved the abdominal discomfort. His temperature on admission was 100°. W. B. C., 10,450. Soon after being put to bed the patient vomited and the vomitus contained yellowish bile. The blood smears were negative for malaria.

The day after admission his temperature was 99°, and he felt better, though he remained somewhat nauseated. He was given small amounts of peppermint water, which relieved the nausea. From November 24 until the 26th the patient was apparently much improved and was allowed to have a light, fat-free diet. Icteric condition of skin and scleræ did not clear up. At about daybreak on the 27th he was seen by a hospital corps man to get out of his bunk and start walking around the ward in an aimless manner. When the corps man attempted to put him back in bed, he found that the patient had difficulty in talking and appeared to be delirious. He was therefore put under the care of a special watch. At this time his temperature was found to be 99°, and his white blood cells were 17,600. Physical examination revealed a ptosis of the left eyelid. The pupils reacted normally to light and in accommodation. The patellar reflexes were absent, but all other reflexes were apparently normal. There appeared to be a slight hemorrhage from the gums, and there was some blood on the tongue. The throat was negative. Heart and lungs were negative. The abdomen was soft and there was no rigidity nor mass. The spleen was not enlarged. The lower border of the liver was palpable about 3 inches below the costal margin. Genitalia and extremities were negative. At about 7.30

a. m. he vomited, and vomitus contained traces of blood and bile. He was transferred to the U. S. S. *Relief* for further treatment.

Laboratory examinations done aboard the *Relief* showed that he had a R. B. C. of 3,930,000; Hb. 80 per cent; W. B. C., 16,400; Polys., 72 per cent. Urine: Sp. Gr. 1,015; albumin, 3 plus; positive for bile; sugar, negative; blood, negative; negative for arsenic, leucin, and tyrosin. Microscopic examination of urine: Many granular casts; icterus index, 120. Immediate direct Van den Bergh. Fragility of red cells, normal. Blood chemistry: Sugar, 98; nonprotein nitrogen, 30.3; urea, 13.6; creatinin, 1.21. Blood Kahn, negative. Spinal fluid Kahn, negative. Blood cultures, negative.

The patient failed to respond to treatment and continued to grow worse. Soon after admission to the U. S. S. *Relief* he became maniacal. Death occurred at 10.15 p. m., November 28, 1927.

The following is a report of the autopsy performed aboard the *Relief:* The body of a well-developed, fairly well nourished, young adult male. Height, about 66 inches; weight, about 140 pounds. Skin and scleræ, intensely jaundiced. Blood exuding from mouth. Several small patches of petechial hemorrhages in the skin on arms and trunk.

*Chest.*—Tissues of chest wall, very yellow. Pleura, yellow. Pericardium and pericardial fat, yellow. Pericardial sac contained about 100 c. c. clear yellow fluid.

*Heart.*—Small in size. Musculature, good. Weight, 275 grams. Valves, good. Endocardium, yellow.

*Lungs.*—No pleural adhesions. Posterior half showed post mortem congestion, otherwise lungs normal.

*Abdomen.*—Abdominal fat, peritoneum, omentum, stomach, intestines, and mesentery, yellow. Few petechial hemorrhages along the mesentery.

*Liver.*—Small. Weight, 1,160 grams. Brownish yellow in color. Outline, smooth; capsule, not shrunken. On cut section, yellowish brown in color. Seemed more moist than normal. Grossly, no disintegration. Chemical examination of liver negative for arsenic.

*Gall bladder.*—Gall bladder, small. Weight, 40 grams. Walls, thickened and inflamed. Fluid, thick and blackish. Adherent to duodenum and omentum.

*Spleen.*—Weight, 175 grams. Normal in color. On cut section, showed congestion.

*Pancreas.*—Normal.

*Stomach and intestines.*—Contained small amount of pinkish yellow fluid and the walls were slightly congested.

*Kidneys.*—Weight, 175 grams each. Very yellow in color. Capsules stripped easily. Surfaces show petechial hemorrhagic spots. Cut section showed acute inflammation and a normal amount of cortex. Pelves and calices, very yellow.

*Bladder.*—Contained about 100 c. c. dark urine.

*Skull cap removed.*—Meninges, yellow. Surface vessels of brain, engorged. Cerebrospinal fluid from foramen magnum, bloody; that under the tentorium, clear and yellow. Sections of the brain were made and no pathology found.

## CONCLUSION

The etiological factors in the case are obscure. Syphilis and arsenical poisoning were considered. Owing to the facts that the patient was given prompt treatment soon after the discovery of the *Spirocheta pallida* in the lesion on his penis, and that both blood and

spinal fluid Kahn tests were negative, the possibility of syphilis was discarded. Likewise, since the patient received only a total of three and a half doses of neosalvarsan and the last dose was given on August 17, three and a half months before death occurred, it is believed that this could not be a factor in the etiology. In addition, chemical examination of the liver was negative for arsenic.

In the main, the symptoms are those of Weil's disease, with the exception of splenic enlargement, which did not occur in this case. The spirochetes, however, were not demonstrated in blood or urine.

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## SANITARY MOUTHPIECE FOR INSTRUCTOR PILOTS[1]

By Geo. C. Rhoades, Lieutenant Commander, Medical Corps, United States Army

The individual sanitary mouthpiece described below is used by pilot instructors in conjunction with the Gosport helmet worn by all aviation students when undergoing instruction in flight training here at Pensacola. It was designed by the writer.

The mouthpiece is made of No. 2 white canvas cut according to pattern. This weight of canvas was selected as it has been found heavy enough to keep the wind from blowing it in against the instructor's mouth while instructing. The edges are bound with one-half inch white tape. The mouthpiece is held tightly around the flexible voice tubing by means of two snap-button fasteners, size 28. The upper corners of the mouthpiece are reinforced with imitation black leather, a slit is cut through this wide enough to permit the passing of an elastic tape with a sliding buckle which allows the pilot properly to adjust the mouthpiece.

By using the above-described type each instructor has his own mouthpiece which is easily clamped by the glove fasteners around the voice tubing, on the end of which is secured a piece of heavy rubber tubing three-fourths of an inch long. This latter holds the voice tubing firmly in the bottom of the mouthpiece.

Prior to adopting this mouthpiece each student carried one which was permanently secured to the voice tubing of his helmet. This mouthpiece was continually being dragged around in the dirt and it was practically impossible to keep it clean and sanitary at all times. Again a student may be checked and rechecked by several different instructors the same day and with the old type each one had to use the same mouthpiece, and it was found, in addition to being a most insanitary arrangement, that respiratory infections were being transferred from one instructor to another.

[1] From U. S. Naval Air Station, Pensacola, Fla.

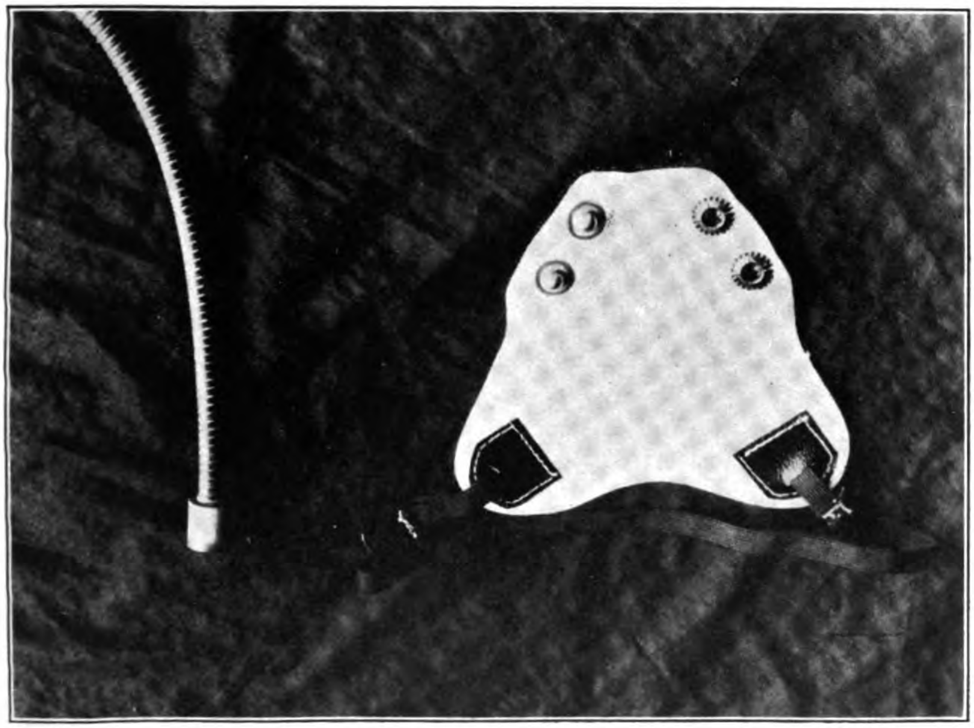


Fig. 1.—Mouthpiece and flexible voice tube

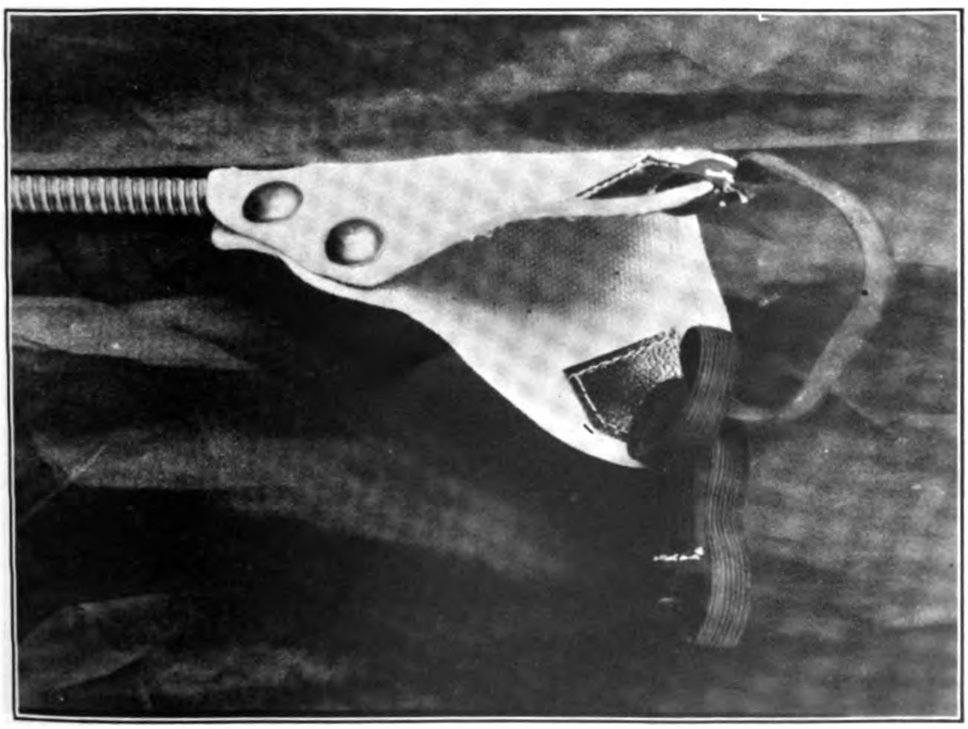


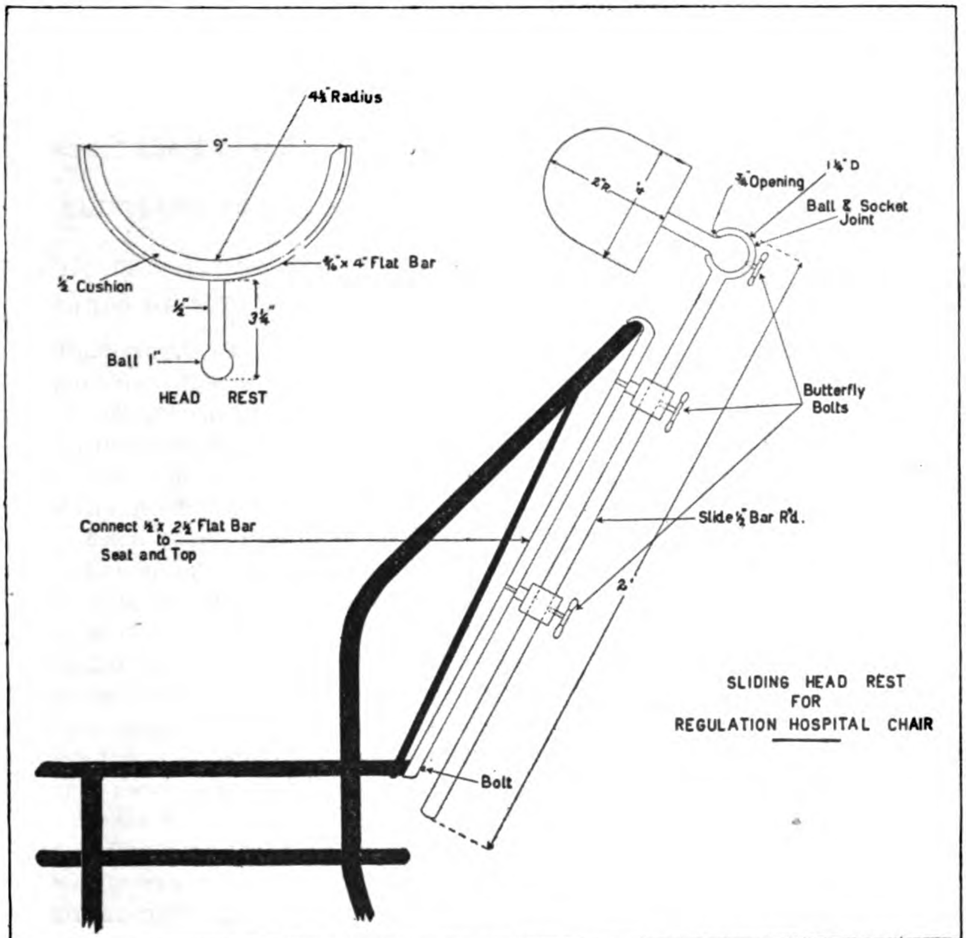
Fig. 2.—Mouthpiece and flexible voice tube connected

## AN ADJUSTABLE HEADREST

By C. B. CAMERER, Commander, Medical Corps, United States Navy

The need for a practical headrest, for work about the throat, ears, teeth, nose, eyes, or the head in general, frequently arises on board ship, necessitating the adoption of more or less unsatisfactory expedients.

A plan, with sketch, is submitted for an easily constructed, readily adjustable, rigid, and entirely practical device of this nature; one




that can usually be turned out by the ship's force, on a repair ship, or at any naval station.

By two simple locking bolts it can at once be attached to the regulation pattern of hospital chair, or for that matter, to any solidly constructed wooden one.

The cost is low and, when nickeled, the headrest is quite presentable. The cushion may readily be covered by coffee-bag material as issued.

The appended drawing (fig. 1) by Chief Pharmacist's Mate J. A. Kennedy, United States Navy, is self-explanatory and due acknowledgment is hereby given him for his interest and intelligent cooperation in designing this apparatus.

# NAVAL RESERVE

During January and February of 1928, the Chief of the Bureau of Navigation issued three letters to the commandants of all naval districts, which contain much of interest to the medical members of the Naval Reserve, as well as to other reservists. These letters are quoted below. In all places where the letters speak of "the Bureau," the Bureau of Navigation is referred to.

## QUALIFICATIONS FOR APPOINTMENT OF SPECIAL-SERVICE OFFICERS

This title is the subject of a letter dated January 11, 1928, the substance of which follows:

1. Paragraphs (1), (2), (3), (4), and (5) of article H-3402, Naval Reserve Regulations, refer to the qualifications necessary for appointment as special-service officers as follows:

The bureau will allot quotas of special-service officers of the various classes to:

(*a*) Each bureau and office of the department for war duty directly in or under the bureau or office.

(*b*) Each naval district for war duty in the district.

(*c*) Commander in Chief, United States Fleet, for staff duty in the fleet.

(*d*) Director, Naval Transportation Service, for staff duty in that service.

The various agencies allotted quotas of special-service officers will designate to the Bureau of Navigation, via the appropriate bureau or office of the Navy Department, the persons they desire to fill their quotas and will recommend ranks commensurate with that of their professional attainments, but not to exceed that of lieutenant commander. For appointment as a special-service officer a candidate must have resigned from commissioned rank in the regular Navy under honorable conditions or have graduated from the Naval Reserve Officers' Training Corps or be prominent in his profession.

The Bureau of Navigation will take final action on all applications and obtain the appointments from the President.

Special-service officers will be procured only for specific duties in the war organization of the Navy. This will not prevent their utilization to the best advantage in any duty, including sea duty, during war time.

Special-service officers must be found physically qualified to perform the specific duties for which they are appointed.

2. The bureau realizes that it is impossible to set down specific requirements for appointment in this branch of the Naval Reserve and contemplates no changes in the above regulations. It has been noted that, in a few cases, quotas have been exceeded and, in the opinion of the bureau, the rank recommended has not been commensurate with the candidate's professional attainments and position in civil life. This has led not only to a wide variation of age in grade, but to the question as to whether the grades held represent the

relative professional merit and civil position (occupation) of the officers concerned, when considered from the standpoint of the whole Naval Reserve.

3. It is evident that the bureau can not pass on the merits of each candidate, and, of necessity, must leave to the commandant, who is in personal touch, the estimate of the grade for which a candidate is best qualified. However, for the sake of uniformity, it seems befitting to establish minimum ages for appointment to the various grades as follows: Ensign, 21; lieutenant (junior grade), 25; lieutenant, 31; lieutenant commander, 37.

4. The bureau desires to invite the attention of commandants to the fact that the rank of lieutenant commander should be reserved for those who not only are prominent and outstanding figures in their profession, but who enjoy the greatest respect and leadership in their community. Where, for instance, the candidate is a technical man of a large company, his rank should depend on his position in the company, as well as his professional attainments, bearing in mind that the president of the company himself could not be appointed in grade higher than lieutenant commander; the rank of a lawyer in class L–V (S) or the rank of a doctor in MC–V(S) should depend on the character and volume of his practice; the rank of a C–V(S) officer should depend on the size of the activity with which he is affiliated and the importance of his position therewith, and similarly for the other classes of special service.

5. In all cases, before recommending a candidate for appointment as a commissioned officer, the commandant should assure himself that the applicant is a man who commands the respect of the community in which he resides, one of unquestioned integrity, of suitable education and attainments, and of a character that will preserve the high caliber of officer qualification and reflect credit on the naval service.

6. The bureau wishes strict compliance with that part of the regulations which provides that candidates, other than those who have resigned from the Navy under honorable conditions or graduated from the N. R. O. T. C., must be prominent in their profession.

R. H. Leigh.

## COMMISSIONS FOR NAVAL RESERVE OFFICERS AND TRANSFER BETWEEN CLASSES OF OFFICERS IN THE NAVAL RESERVE

The letter of January 17, 1928, treats of these subjects and refers to article H–2404(2), United States Naval Reserve Regulations. Article H–2404 reads as follows:

(1) Officers of the Volunteer Naval Reserve who have held permanent commissions in the regular Navy may be transferred to the Fleet Reserve with the permanent rank held by them in the regular Navy. These officers will be carried on the precedence list as extra numbers.

(2) Other candidates may be transferred or appointed only at the foot of the list of ensigns in classes D–F, E–F, DE–F, A–F, and SC–F or lieutenants (junior grade) in class MC–F.

The letter states:

1. The restrictions placed upon recommendations regarding transfers of officers from the Fleet Naval Reserve to the Volunteer Naval Reserve, or vice versa, in reference (*b*), are hereby rescinded.

2. Hereafter the following procedure will be followed in the appointment of officers in the Naval Reserve and in transfers between classes:

(*a*) Officers appointed will be commissioned in the Naval Reserve of the United States Navy.

(*b*) When originally appointed, each officer will be assigned to a class of the Naval Reserve by letter of the bureau of Navigation, such assignment to be effective upon the date of execution of acceptance and oath of office.

(*c*) A new commission will not be issued to an officer now holding a commission in the grade and rank to which he is entitled, since his present commission, in a certain class, is sufficient to establish his status in the Naval Reserve.

(*d*) Transfers of officers will hereafter be accomplished by letter from the Bureau of Navigation. Such a transfer is effective from the date set forth in the letter accomplishing it and is not dependent upon acceptance by the officer concerned.

(*e*) An officer transferred between classes of the Naval Reserve will be transferred in the grade in which serving and will retain the date of precedence stated in his commission in that grade.

3. The bureau is now taking steps to bring transfers heretofore accomplished, since July 1, 1925, into accord with the procedure set forth above.

4. The requirements for appointment in or for retaining membership in any class of the Naval Reserve will be prescribed by the Secretary of the Navy.

5. The bureau does not contemplate any essential modifications of the present requirements for retaining a status in the Fleet Naval Reserve.

6. The bureau is now prepared, subject to the restrictions of paragraph 5, to give consideration to such requests for transfers between classes as the commandant may desire to recommend.

R. H. LEIGH.

The third letter of this series, which follows, amplifies the letter above in so far as transfers between classes are concerned. In it "Reference (*a*)" refers to the letter of January 17, 1928.

1. Reference (*a*) sets forth the bureau's policy regarding the transfer of officers of the Naval Reserve between classes, without loss of rank or of date of precedence in rank. In carrying out that policy it is desired that the following principles be observed, and district commandants should be guided accordingly.

TRANSFERS TO THE FLEET RESERVE

2. The sole reason for transfer of officers to the Fleet Naval Reserve is to build up and strengthen the organizations thereof. An officer so transferred should be a distinct asset to his organization. The bureau will give consideration to an application for transfer from the Volunteer Naval Reserve, general service, when it complies with the following conditions:

(*a*) When recommended by the commandant of the naval district in which the applicant resides.

(*b*) When the applicant is needed to fill a vacancy in an authorized Fleet Naval Reserve organization, and is in a position to attend drills with that organization and to otherwise maintain efficiency.

(*c*) Provided the applicant has qualified by examination for his grade in the Volunteer Reserve. If not so qualified, then he will be required to qualify by examination before transfer.

(*d*) Provided the applicant's record in the naval service is satisfactory and that he has manifested a degree of interest that would seem to mark him as a desirable officer for the Fleet Naval Reserve, and an asset to his organization.

3. When forwarding an approved application for transfer to the Fleet Reserve the commandant should specifically comment on each of the requirements set forth in subparagraphs (*b*), (*c*), and (*d*).

4. The bureau does not contemplate transfers from the Volunteer Reserve, special service, to the Fleet Reserve.

TRANSFERS FROM THE FLEET RESERVE

5. The bureau will give consideration to recommendations from the commandant for the transfer of officers from the Fleet to the Volunteer Reserve.

(*a*) When such officers are not maintaining efficiency in accordance with the requirements of subparagraphs (*c*) and (*d*), article H-2601, United States Naval Reserve Regulations.

(*b*) For any of the reasons set forth in subparagraphs (*f*), (*g*), or (*h*), of article H-2601, United States Naval Reserve Regulations.

6. The bureau does not desire to continue officers in the Fleet Reserve when they repeatedly fail to take training duty. It is, therefore, suggested that each commandant investigate the records of all Fleet officers under his command and make appropriate recommendations for transfer to the Volunteer Reserve of such of these as have repeatedly failed to take the required active or training duty.

7. In all cases where transfer to the Volunteer Reserve is recommended, the recommendation should be referred to the officer concerned before being forwarded to the bureau for action.

8. Officers of the Fleet Naval Reserve or the Volunteer Naval Reserve, general service, who are found not physically qualified for combatant duty afloat will be either—

(*a*) Honorably discharged.

(*b*) Transferred to the honorary retired list, or

(*c*) If qualified therefor, and a vacancy exists, transferred to one of the classes of special-service officers.

R. H. LEIGH.

Article H-2601, United States Naval Reserve Regulations, reads as follows:

Officers of the Fleet Naval Reserve may in the discretion of the Bureau of Navigation be transferred to the Volunteer Naval Reserve [illegible] causes:

(*a*) Upon application of officer con[illegible].

(*b*) Upon recommendation by command[illegible] officer for failure to maintain efficiency.

(*c*) Failure to attend not less than [illegible] drills or periods of equivalent or appropriate duty in any one fiscal year.

(*d*) Failure to maintain efficiency by taking training duty.

(*e*) Failure to pass any physical examination.

(*f*) Failure to pass professional examination for promotion.

(*g*) Failure to appear for an authorized examination for promotion.

(*h*) Removal of residence to a new location where there is no organized unit of the Fleet Naval Reserve or where the commandant does not desire to include him in his district quota of officers.

## NEW APPOINTMENTS

| Name | Rank | Class | Date appointed |
|---|---|---|---|
| Behneman, Harold M. F | Lieutentant (j. g.) | MC-V(G) | Feb. 20, 1928 |
| Brunschwig, Alexander E | do | MC-V(G) | Oct. 3, 1927 |
| Caro, Lemuel | do | MC-V(G) | Jan. 20, 1928 |
| Davidson, Arthur J | Lieutenant commander | MC-V(S) | Mar. 5, 1928 |
| Dyke, Cornelius G | Lieutenant (j. g.) | MC-V(G) | Nov. 12, 1928 |
| MacPherson, Frazer L | Lieutenant | MC-V(S) | Dec. 19, 1927 |
| Randall, Samuel B | Lieutenant (j. g.) | MC-V(G) | Dec. 27, 1927 |
| Sala, Roland O | do | MC-V(G) | Feb. 2, 1928 |
| Sasser, Thomas J | do | MC-V(G) | Feb. 6, 1928 |
| Schmoele, John M | Lieutenant commander | MC-V(S) | Oct. 18, 1927 |
| Youmans, Comer R | Lieutenant (j. g.) | MC-V(G) | Mar. 30, 1928 |
| Zapffe, Fred C | Lieutenant commander | MC-V(S) | Mar. 16, 1928 |

## TRANSFER

| | | | |
|---|---|---|---|
| Wood, Archibald O. M | Lieutenant | MC-V(G) from MC-F | Jan. 10, 1928 |

# NURSE CORPS

## THE RESERVE NURSE CORPS OF THE UNITED STATES NAVY

In the January number of the United States NAVAL MEDICAL BULLETIN there appeared a long article on "The Naval Reserve," referring particularly to the Reserve Medical Corps of the Navy.

The reserve of the Navy Nurse Corps is somewhat different. The bill authorizing the establishment of the Navy Nurse Corps included the authority to appoint reserve nurses as needed. It also states that reserve nurses may be assigned to active duty when the necessities of the service demand, and when on such duty shall receive the pay and allowances of nurses of the regular Navy. The reserve nurse, upon taking her oath of office, agrees to serve whenever needed. When her services are no longer needed, she is ordered to her home for release from active duty and, if honorably discharged and she so desires, her name is placed upon a list of those who may be recalled to active duty in case of war or emergency. A nurse, whose name is on the reserve list, is dropped from the list upon reaching the age of 45 years.

The duties of the reserve nurse may be identical with the duties of the nurse, United States Navy, and many of the privileges are granted to all members of the Nurse Corps, reserve or regular. There are some privileges, however, which the reserve nurse may not enjoy. The opportunity to take special courses at the expense of the Government is not open to reserve nurses; the six months' gratuity to a dependent relative, in case of death while on active duty, is not granted for reserve nurses, and the privilege of retirement for length of service is confined to nurses in the regular Navy.

The Red Cross Nursing Service has the responsibility of maintaining a nursing reserve for the Army and Navy adequate to meet the country's needs in time of national emergencies. This reserve is authorized by congressional enactment. During the World War, there was a great demand for nurses in the military and naval services. To meet this call the standard, particularly as to age and physical fitness, was somewhat lowered, as the reserve nurses were appointed, as a rule, only for the period of the war and many nurses were accepted for the emergency who would not now meet the requirements. Some of these nurses were enrolled as nurses of the United States Naval Reserve Force, but in 1920 this branch of the reserve was discontinued. Those who wished to remain in the service for a longer period were transferred to reserve nurse, or to nurse, United States Navy.

Organized Red Cross Units, if accepted for service with the naval forces, are enrolled as members of the Naval Reserve Force and constitute a part of the medical department of the Navy. Nurses are included in the personnel of these units.

As the name implies, the reserve nurses are called upon to augment the rolls of the regular Nurse Corps. In times of peace, the Navy Nurse Corps, as a rule, does not require the service of reserve nurses, but expects to carry its full quota of regular nurses for active duty.

During a severe epidemic among the Navy personnel, if there is need for additional nurses for a short period of time, the nurses who respond to the call are appointed reserve nurses and they are retained only so long as the emergency lasts.

Sometimes nurses who apply for appointment do not qualify for the regular Nurse Corps, then they may be appointed reserve nurses if there is need for their services. If, after a period of time, they meet all requirements, they may be transferred to the regular Nurse Corps. At the present time no reserve nurses are being appointed for active duty.

## ASSISTANT SUPERINTENDENTS, NAVY NURSE CORPS

The duties of the assistant superintendents of the Navy Nurse Corps who are stationed at the ninth and eleventh naval districts are not wholly understood by all of the nurses. Their work is of interest and of great value in enlightening the public and the nurses in civilian life on one branch of the Navy that is comparatively little known, the nursing service.

During the World War the nursing services of both the Army and the Navy became very well known, for all qualified nurses were eager to do their part in the great conflict and they allied themselves with one of the military services or with the American Red Cross. After the war, most of these nurses gradually left the service to return to their duties in civilian life.

In the Navy, many of the hospitals have been closed, and, though the number of nurses required to carry on the work is very much smaller than during the war, the hospitals have never returned to their former peace-time basis. This is due, partly, to the fact that veterans of the World War are cared for in the naval hospitals, greatly increasing the number of patients and bringing in patients of a different type. The men on active duty in the Navy and Marine Corps are physically fit and, with few exceptions, their stay in the hospital as patients is of short duration. On the other hand, veterans of the World War are, as a rule, chronic cases, and oftentimes they remain in the hospital under treatment for months at a time.

It follows, therefore, that the ratio of patients in the naval hospitals to the active personnel of the Navy is greater than before. More nurses are required to carry on the work, and the field of activity for nurses has changed somewhat. The opportunities for nurses in civilian life are greater than they were 15 years ago and a small proportion of them settle down to a life of private nursing only. So it is in the Navy. All nursing work is planned with benefit to the patient as its ultimate result, but not all nurses in the Navy do bedside nursing.

Any organization wishes its personnel to be of the highest type. It is unfortunate that many times nurses' organizations are judged by their poorest members rather than by the majority or the best. To avoid unfair or unjust criticism of the whole, the Navy Nurse Corps is striving to have none but the best and, in order to do this, the work must be sold to the public and particularly to the nursing public.

It is just this that the assistant superintendents are doing, by bringing the work of the Navy Nurse Corps to the attention of training schools and to groups of graduate nurses. They really act as liaison officers between the Navy Nurse Corps and the training schools for nurses. They are equipped with a working knowledge of the Nurse Corps and are able to present to their audiences a very clear idea of the many-sided life of the Navy nurse. They have slides to illustrate their talks, thereby giving visual expression to their ideas. The nurses have been very much interested and many applications for appointment have been received. The Surgeon General is able to select from the applicants only those who seem best qualified. That poor ones are selected occasionally is partly due to the fact that accurate information as to applicants is not always received and, further, that desirable applicants do not always fit into the type of work that the Navy Nurse Corps requires, and seem poor in consequence. As a rule, the misfits from whatever cause weed themselves out sooner or later.

The reports from the assistant superintendents are very interesting. A résumé of one shows that from October 16 to December 3, 1927, talks were given before 14 different groups in as many cities. In some cities the group consisted of the instructors and senior pupils from several training schools. In all, more than 1,500 pupils and graduate nurses were present. Fifteen minutes were utilized in setting forth the reasons a graduate nurse should wish to become a member of the Naval Nursing Service and in explaining the requirements for appointment, method of making application, and the obligation involved in the oath taken. Forty minutes were devoted to the showing of the slides and 5 or 10 minutes given to answering questions. The report shows that in each city there was enthusiasm

on seeing the pictures. Interest was expressed frequently in the large number of stations to which nurses may be assigned, in the fine appearing hospital buildings and attractive quarters for nurses, in the variety of nursing activity for the Navy nurse, in the special courses of instruction granted, and in the advantages of the retirement law.

Each assistant superintendent covers her district, making her contacts through one of the State or district nursing organizations or perhaps through the director of a school of nursing. They have received hearty cooperation from all. When it is recalled that each naval district includes many States it may readily be seen that the assistant superintendents come in contact with a large number of nurses, many of whom have never heard of the nursing in the Government services. It opens up a new field for them, and the graduates of to-day are constantly looking for new fields in their profession. A tour of duty with the Navy is bound to be different from anything they have done before, and the idea of moving about appeals to the nurses of this restless and progressive age.

## INTERNATIONAL COUNCIL OF NURSES

Perhaps all nurses do not know about the International Council of Nurses which meets every four years in some country whose national nursing organization is a member of the council. The selection of the meeting place is voted upon by the board of directors, from the invitations received from the different countries. The last meeting was held in Helsingfors, Finland, in 1925, and the United States Navy Nurse Corps was represented by some of its members.

At that meeting the nurses from China extended a very cordial invitation to the council for the nurses to hold the next meeting in Peking in 1929. That invitation was accepted, but later, owing to the unsettled conditions in China, the invitation was recalled, much to the disappointment of all. The Canadian Nurses Association then invited the council to meet in Montreal in 1929, and this invitation has been accepted.

In connection with this, it is well to remind the nurses that unless a nurse is a member in good standing of her alumnæ association she is not a member of the American Nurses Association. When new nurses apply for appointment in the Navy Nurse Corps, if they are not members of their alumnæ associations, they are advised to join, or to become reinstated. Recently a secretary of a school alumnæ association wrote to the bureau to inquire why a nurse must become a member of her alumnæ association to be eligible for appointment, but is not obliged to keep up her dues and remain in good standing after she is appointed. It is to be regretted if there are those who through care-

lessness or indifference have allowed their dues to lapse. The American Nurses Association represents what is highest and best for the nursing profession in this country and every nurse should give the organization her individual support by remaining a member in good standing of her school alumnæ and by attending meetings whenever possible and using her power of vote.

This past year, in June, an interim conference of the International Council of Nurses was held at Geneva. It is not easy for the Navy nurses to attend the meetings when they are held so far away, as it is not only an expensive trip, but it takes so much time for the actual travel to and from the place of meeting. Those who can spend the time and money always feel repaid and nurses are still talking about the wonderful program the civic authorities and the nurses of Finland arranged for them.

For us in the United States, Canada seems very near and it is hoped that more will be able to attend the sessions of the council there to receive the inspiration and help which one always gets from personal contact with the leaders of the profession. The bureau feels that the benefit received from attending such a conference is valuable to the nurses and to help them in the matter of time, actual time consumed in attendance is counted as a duty status, but the expenses incident thereto must be borne by the nurses.

An editorial in the British Journal of Nursing of August, 1927, on the interim conference is reprinted. It is stimulating and makes one feel that one would like to attend every meeting. It is hoped that the Navy nurses will keep the meetings in Montreal in mind, for the summer of 1929 is not so very far distant and plans must be made in advance.

"The interim conference of the International Council of Nurses at Geneva long looked forward to is now a thing of the past, its memories to be added to our storehouse of pleasures, and brought out from time to time that its lessons may sink deeper and deeper, that we may count our treasures, estimate how much professional knowledge and skill we have gained to bring to the many-sided service that modern society demands of us, and realize how much our lives have been enriched by our intercourse with the nurses of other nations, and by the hospitality so courteously extended to us.

"A more ideal setting for the conference of the nurses of the 34 nations could not have been secured. Geneva, on the lovely lake bearing its name, is preeminently an international city, and the international atmosphere at once made itself felt, and brought us into touch with the nations of the world. It was a specially valuable atmosphere for nurses, whose horizons, by reason of the intensity of their work, are ordinarily restricted, and a revelation to those who attended a conference convened by the International Council

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of Nurses for the first time of all that it denotes—the recognition of the importance and dignity of the profession of nursing by the civic authorities who entertained the members of the conference so hospitably and charmingly, the stimulus of contact with the nurses of the world, the beauty of the surroundings, could not fail to inspire the conference members and to impress them with the fact that 'the International Council of Nurses does not stand for a narrow professionalism, but for the full development of the human being and citizen in every nurse.'

"We place high in importance among the objects of the International Council of Nurses the opportunity of personal intercourse, a point strikingly emphasized by the Prince of Wales when, speaking at the Government dinner at Parliament Buildings, Ottawa, on August 2, His Royal Highness said, 'If there is one lesson which more than another has been learned in these postwar years, it is the lesson of the immense value of man-to-man intercourse.'

"We of the International Council of Nurses know well the pleasure and the profit of meeting nurses of other nations, of the friendships formed and cemented, and of the good will engendered. Correspondence is a poor substitute for personal contact, and one revelation which has resulted from 'man-to-man intercourse' is that we realize the similarity of our aims, and are agreed that the duty of the nurse is to prove by her consistent, altruistic methods, the grace and moral value of kindness, and that if the trained nurses of the world united to demonstrate the beauty of holiness, the blessings of peace between the nations would be surely and imperceptibly advanced. For in the tangled politics of the world, trained nurses hold a specially privileged position, inasmuch as down through the ages their work has been the humanitarian work of the prevention and cure of disease. There is no nationality in nursing. Wherever in peace or in war we find sickness or suffering there it is our duty to endeavor to heal and to comfort, be the patient friend or foe.

"There is no body of professional workers who take the pleasures which come their way more happily and gaily than trained nurses, and yet they are marked with a certain soberness and restraint which indicate that they are a class set apart, charged with the responsibilities which leave their mark upon them. For the profession of nursing deals with sacred things—not only with the body but with the spirit of man—with the mysteries of birth, life, health, sickness, and death. It stands on the threshold of the unseen and the unknown. It is our privilege not only to help to revive the current of life but to solace and comfort those whose feet shrink from the touch of the chill waters of death, and the cheerfulness and gaiety of nurses should have their root in soberness of thought, and steadfastness of conduct—for who is sufficient for these things?"

# NOTES AND COMMENTS

## YATREN: A CORRECTION

In the article "General considerations on amœbic dysentery and endamœbic carriers, from the viewpoint of a naval surgeon," by Commander M. A. Stuart, Medical Corps, United States Navy, which was published in the April, 1928, number of the BULLETIN, it was stated, on page 436, that Yatren "is a combination of iodine with oxyquinoline-sulphuric acid, etc." This in an error; "oxyquinoline-sulphuric acid" should have read "oxyquinoline-sulphonic acid."

## RABIES AND ANTIRABIC TREATMENT

From time to time reports of deaths from rabies and papers and comments on this disease have appeared in the BULLETIN.

At this season of the year, when cases of rabies are generally expected to be most numerous, it appears desirable again to call attention to the dangers of this disease and to the methods of preventing its occurrence.

Rabies to-day is the same as it was long ago, and the precautions which should be taken now are the same as those advised in the past. For this reason the advice given in a paper by Sir David Semple, entitled "On the nature of rabies and antirabic treatment," which was published in the British Medical Journal so long ago as September 13 and 20, 1919, is still applicable. A brief summary of this paper will be given.

The author wrote that, since prevention of rabies in countries like the British Isles is easy, and cure after the disease has developed is practically unknown, all efforts should be directed toward prevention.

Ordinarily, he said, the term "rabies" is applied to the disease in animals and "hydrophobia" to its occurrence in man. This is misleading, as hydrophobia is only a symptom brought on by fear of the severe muscle spasm which occurs when a sufferer from rabies attempts to swallow water or any other liquid. There is no "fear of water" as such. It would be better, therefore, to discard the term "hydrophobia" and speak of the disease as "rabies," whether in man or beast.

The steps to be taken after a man has been bitten by an animal that might be rabid are, according to Sir David Semple, as follows:

The dog should not be destroyed, but should be kept under control and close observation for a period of 10 days from the date of the bite, and in the event of any symptoms of ill health or departure from its normal habits a report should be made to the police at once. If still healthy and free from any symptoms of rabies, the person bitten has nothing to fear as regards infection; even though the animal should develop rabies on the eleventh day or on any subsequent date, no antirabic treatment would be required.

If the dog showed signs of rabies within 10 days from the date of inflicting the bite, the person bitten should receive antirabic treatment as soon as possible after the condition of the dog had declared itself.

A person severely bitten on the head, face, or neck would not be justified in waiting 10 days to know whether the animal was infective or not. A delay of 10 days, or even 4 to 5 days in a case of that kind might be disastrous, as it might then be too late for successful treatment; the safest course to adopt in such cases would be to commence antirabic treatment at once, and as soon as it became evident that the dog was not infective leave it off. In a rabies-infected district a person bitten by a stray dog which subsequently disappeared and was not again seen or heard of should receive antirabic treatment as a precautionary measure.

It is evident that in a rabies-infected area it would be a mistake to destroy a healthy looking dog immediately after it had bitten anyone, because then all information regarding his condition would be lost unless the carcass or a portion of the brain was sent to a laboratory for experimental tests, which would mean a delay of from four to five days, up to a period of three weeks, or possibly longer, according as to whether Negri bodies were looked for and found, or the inoculation of an animal carried out.

Drs. Thurman B. Rice and Norman Beatty, of Indiana, sent questionnaires to the health officers of every State in the Union, to all the Provinces of Canada, and to practically all foreign countries in an effort to determine the extent to which rabies in animals and in man prevailed throughout the world. They published their results in the American Journal of Public Health for April, 1928. The conclusions reached by them are as follows:

"1. Rabies is on the increase in the United States, or at least was so two years ago.

"2. It increased in Europe during the Great War but has declined somewhat during the last three to five years there.

"3. It has been completely eradicated from certain countries, while in others it has apparently never existed.

"4. In the main, rabies is more prevalent in those parts of the world where civilization is retarded and poverty prevails."

Chicago's Health, the weekly bulletin of the Chicago Department of Health, in No. 5 of Volume XXII, says:

"Rabies (hydrophobia) has been one of the serious problems of the health department during the past year. In 1927, 399 dogs' heads were examined for rabies in the department laboratories. Of

these, 183 were found positive, which represents over 10.5 times as many positives as for the whole of 1926. Eight human deaths from rabies occurred during the year, seven decedents being Chicago residents. These are the first rabies deaths reported in the city since 1920. There were 259 Pasteur treatments for the prevention of rabies given by the department of health during the year."

Illinois Health News, March, 1928, says that the State is infested with mad dogs and that last year (1927) was the worst in the State's experience with rabies, but the situation seems to be growing even worse.

This journal points out that rabies is far more prevalent in the spring than in August and September, the "dog days" season, and states that all valuable dogs should be muzzled and all ownerless dogs destroyed.

Illinois is not the only State that is finding rabies a serious problem. The Weekly Bulletin of the city of New York Department of Health in its issue of December 10, 1927, stated that in the 10 years prior to 1927 there were 2,821 persons bitten by rabid dogs and treated by the department. Of these, 18 died of rabies. In 1927, up to the time of issue of the bulletin, there had been 309 persons treated for rabid dog bites. Six deaths from rabies had occurred during the year. The increase appeared ominous.

This periodical calls attention to the fact that "the first symptoms of rabies observed in the majority of dogs is that they suddenly attack and bite someone." Dogs should not only be muzzled, but they should be effectively muzzled. The necessity for prompt treatment in all suspicious cases is emphasized, and one paragraph in particular seems worth quoting:

"It is a good plan to first encourage bleeding from the wound, using suction if necessary, and to follow this by the thorough application of the one effective caustic—nitric acid. In two of the six reported deaths, phenol was used; in one, tincture of iodine, which is useless, and in the remaining three no cauterization is reported."

The issues of the Weekly Health Review of the department of health of the city of Detroit of April 7 and April 14, 1928, are largely devoted to the subject of rabies and call attention to the enormous increase in the number of mad dogs which have recently appeared in Detroit.

During the first three months of 1928 there were 834 reports of persons having been bitten by mad dogs in Detroit. Pasteur treatment was given to 201 persons, and 151 dogs are known to have been rabid.

In Detroit the only dogs which are lawfully entitled to be on the streets are those which are licensed and which have been vaccinated

against rabies. However, the streets are full of stray dogs and the vaccinated dogs are largely kept indoors because they are valuable. The city is making tremendous efforts to get rid of all stray dogs and threatens court action against owners of dogs who allow the animals to roam the streets in defiance of the law.

Explicit instructions as to the steps to be taken in case of being bitten by a dog are given in the Review of April 14. These are well known to medical men, so will not be repeated here. It is well, however, to emphasize their importance to all laymen.

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### THE SPECIFIC TREATMENT OF LOBAR PNEUMONIA

The caption above is the title of the twelfth Mellon lecture, read before the Society of Biological Research of the University of Pittsburgh by Russell L. Cecil, M. D., of New York, and published in Archives of Internal Medicine, March 15, 1928.

As is to be expected in a paper on this subject by Cecil, the latest information is given.

Only recently, according to Cecil, have any encouraging results been obtained in the serum treatment of lobar pneumonia. But also it was only 17 years ago that it was discovered that not all pneumococci reacted alike to immune serum. This led to the grouping of pneumococci into the four types with which we are familiar to-day.

The fact that the same person frequently had more than one attack of pneumonia led to the belief that pneumococcic infection did not confer immunity. As Cecil states, this is not the case. The attacks of pneumonia are nearly always due to different strains of the pneumococcus.

In 1917, Cecil and Austin vaccinated a large number of recruits against pneumonia and proved that active immunization against the disease is feasible.

Early attempts to produce an immunizing serum against the pneumococcus failed because the different strains of the organism were not recognized.

The work of Cole and others at the Rockefeller Hospital was the beginning of modern specific serum therapy of pneumonia.

It is now known that immunity against the pneumococcus may be produced in animals either actively or passively.

It has been claimed that a toxic substance may be found in the filtrates of cultures of the pneumococcus. This led to the preparation of an antitoxin, but there has been but little use of it and such as there has been was not encouraging.

The mortality among patients with pneumonia in city hospitals is about 30 per cent. Many of these are elderly and suffering from

chronic disease, but deaths also occur in healthy, young adults. Cecil asks why this is so. Not all die of heart failure. Evidence points in many cases to vasomotor paralysis. Why does heart failure or vasomotor paralysis occur? Cecil points out that fatal pneumonia is usually a septic pneumonia. Cole, in a study of 343 cases, found that the death rate among those with negative blood cultures was only 11.6 per cent; while among those in whose blood the pneumococcus was found it was 67.1 per cent. The more pneumococci present the higher the death rate. While it can not be said with certainty that death in pneumonia is due to pneumococcus septicemia, evidence points that way. Cecil states that in his studies of experimental pneumococcus pneumonia in several hundred monkeys he has never known a monkey to die unless septicemia was present.

Recovery in pneumonia is accompanied by the development of immune bodies in the blood of the patient. These ususally appear at about the time of the crisis. Their early appearance warrants a good prognosis; their absence a grave one. A function of the immune bodies is to prevent the entrance into the blood of the pneumococci. In cases of septicemia, a large amount of the soluble substance of Avery is found. This substance neutralizes the immune bodies. The immune bodies seem to be similar to opsonins, in that they are necessary for the phagocytosis of the organisms. The soluble substance of Avery interferes with phagocytosis by destroying the immune bodies. Hence, the outcome in a given case of pneumonia depends upon which gains the ascendency, the pneumococcus or the leukocytes.

Cecil says:

> In the fight between the pneumococcus and the human host, septicemia spells death and immune bodies recovery for the patient. Herein lies the rationale of our efforts to produce a specific therapy for lobar pneumonia. The modern serum treatment of patients with pneumonia consists essentially in the artificial introduction of pneumococcus immune bodies with the hope of assisting the patient in his efforts to produce immunity against the disease.

Three specific therapeutic agents have been studied by Cecil at Bellevue Hospital. These are: (1) Type I and Type II antipneumococcus serum of Cole; (2) Huntoon's pneumococcus antibody solution; (3) Felton's concentrated antipneumococcus serum. The same therapeutic agents were used in experimental pneumonia in monkeys.

Results obtained by Cole at the Rockefeller Hospital with Type I serum in patients with pneumonia due to Type I pneumococcus have been excellent. Other workers have not reported such good results. Cecil considers that their partial failure may have been due to: (1) Failure to give the serum early enough; (2) insufficient potency of the serum; (3) too small doses; (4) not giving serium frequently enough.

Cecil inoculated two monkeys with lethal doses of Type I pneumococcus culture, and both recovered after four doses of serum.

Type II serum has been disappointing in the hands of most workers. Cole tried it and found it to have no therapeutic value. Later, however, Park managed to obtain a serum of sufficient potency. Cecil tested this serum on a small number of cases at Bellevue Hospital with very encouraging results.

Huntoon, in 1921, prepared a trivalent antibody solution (Types I, II, and III), in which there were only formed antigens, the serum being washed away. The amount of serum which remains in the solution is too small to be determined by chemical means, although its presence is detectable by sensitization tests on guinea pigs.

Huntoon's antibody solution is highly protective against Type I pneumococcus, but is much less so against Types II and III.

Experiments with monkeys convinced Cecil that Huntoon's solution was just as effective against Type I infection as is Type I serum.

Experiments were also conducted to determine the value of Huntoon's solution in Type II and Type III infections. It was found to be of some value in Type II infections and of none in Type III.

The results of treatment of humans with Huntoon's antibody solution closely parallel those obtained in monkeys.

Severe chills and elevations of temperature followed the intravenous injection of Huntoon's solution in practically all cases. Cecil, therefore, tried giving it subcutaneously, with rather disappointing results.

Because of the severe thermal reactions which followed the intravenous use of this solution, Huntoon carried out further experimentation and succeeded in getting rid of the greater part of the reaction-producing substance, so that now it may be given in doses up to 50 c. c. without causing a chill. Of it, Cecil says:

> What the solution of antibody now needs is increased concentration. In a highly potent form it would be an almost ideal product for the specific treatment of patients with the fixed types of pneumococcus pneumonia.

Felton, in 1924, found that "the protective substance was always associated with the water-insoluble fraction of serum, that is, the globulin." He isolated the specific antibodies and redissolved them in concentrated form. Intravenous injections were always followed by thermal reactions. He has since been able to eliminate most of the substances which caused the reactions, and now only about 10 per cent of patients have thermal reactions following its injection.

Felton's concentrated antipneumococcus serum was used by Cecil in monkeys experimentally inoculated with lethal doses of Type I

pneumococcus and the same results were obtained as followed the use of Huntoon's solution and Type I serum.

In patients on his wards, Cecil found that small doses of Felton's serum were just as efficacious as large doses of Huntoon's solution or Cole's Type I serum. In Type II pneumonia, if used early, it also seemed to be of some benefit.

As has been stated, the value of all these agents lies in their ability to produce a protective substance in the blood and thereby prevent septicemia.

According to Cecil:

> The chief function, then, of antipneumococcus serum is bacteriotropic; that is, an opsonization of the bacteria, preliminary to their destruction by the leukocytes. If the blood stream is filled with "soluble substance," it is evident that the patient's own efforts to develop an adequate supply of immune bodies will often be neutralized by the soluble substance of the pneumococcus. If the immune serum is administered early and the administration continued for a sufficient length of time, the soluble substance may be neutralized and an actual balance of immune bodies established in the patient's blood. By such an achievement the pneumococci are properly prepared for phagocytosis and bacteremia is prevented.

The problem now to be solved is how to give potent agents in concentrated form without producing severe reaction. Huntoon's solution is free from horse serum, but is not sufficiently concentrated. Felton's serum is concentrated but is not entirely free from horse serum. Purification and concentration are, then, the problems of greatest importance.

Type III pneumonia seems to be not benefited by any serum. Some cases of Type IV pneumonia are benefited by serum, but this is probably due to foreign protein or the reaction which follows the injection.

The summary of Cecil's lecture follows:

> From the evidence submitted it is clear that antipneumococcus serum and its derivatives, when administered under the proper conditions, are capable of exerting a definite influence on the course of pneumococcus Type I and Type II pneumonia. A specific therapy for these two types of pneumonia is, therefore, theoretically sound. The practical application of the specific treatment of pneumonia is still handicapped, however, by certain defects in the serum itself or in the derivatives from it. Whatever the serum or serum derivative used, the necessity of early and adequate treatment can not be too strongly emphasized. In our experimental work on pneumococcus pneumonia the value of large doses of serum has always been strongly impressed on us.
>
> With numerous investigators now studying pneumococcus infections, there is every reason to believe that each succeeding year will shed further light on the problem. During the past decade much progress has been made, but much more still remains to be done before a thoroughly satisfactory specific treatment is achieved.

## SNAKE BITES

At a meeting of the El Paso County Medical Society, a talk was given by Dr. Afranio do Amaral, director of the Antivenin Institute of North America. The substance of this talk was published in Southwestern Medicine, April, 1928, and it is from that periodical that the following is taken.

An interesting classification of the poisonous snakes of North America is given and methods of prevention of snake bites are mentioned. It is with their treatment only that we are here concerned. Doctor Amaral is beyond doubt one of the greatest living authorities on this subject, so what he says carries great weight. His directions for the specific treatment of snake poisoning follow.

In regard to the administration of antivenin, in case of snake bite inflicted by North American snakes, the Antivenin Institute of America recommends the following treatment.

If you do not have the antivenin with you, everything depends upon carrying out the following procedure (1 and 2) promptly.

(1) Apply a ligature or tourniquet above the bite. This should be applied tightly at first, but must be partially released for a few seconds at 5 to 10 minute intervals so as to maintain the necessary circulation in the limb. There is no particular advantage in making an incision nor in applying permanganate of potassium solution or crystals, or any of the other chemical agents commonly recommended for this purpose.

In fact, it is advisable to avoid any further mutilation or injury of the affected tissues, especially because, should the wound not be kept properly dressed until complete recovery, tetanus or other secondary infection might set in and complicate the patient's condition. In regard to potassium permanganate, it has been shown that, in order to have any effect on the venom, this substance must be used in concentrations that are injurious to the tissues. It has no effect in weak solution and is in itself toxic if used in strong solutions.

Above all, avoid the use of alcohol or any stimulant of that kind. These, by strengthening the circulation, may tend to help the distribution of venom throughout the body. Strychnine or caffeine, however, may be used if symptoms of weakness and giddiness develop.

(2) Proceed at once to nearest place where the antisnake bite serum and medical attention can be obtained.

Remember that the North American snake venoms are usually slow in acting and that, if the antivenin can be obtained within 12 to 24 hours after the bite, the chances of its being effective are good. Of course, the earlier it is used, the more completely effective it is and the quicker the recovery from the ill effects. Meanwhile, the ligature or tourniquet should be kept in place but care should be taken to release pressure at intervals. Otherwise congestion in the limb due to prolonged binding may favor initiation of gangrene. Release the tourniquet as soon as the serum is injected.

If antisnake bite serum is available at the time of the accident, do not apply tourniquet or bandage, but proceed immediately as follows:

The serum for the nearctic crotalidae (rattlesnake, copperhead, and moccasin) is a concentrated antivenin. It is now supplied in North America in 10 c. c. syringes, with a needle and accessories (all sterilized and ready for instant use).

The antivenin can be self-administered, if necessary, in the same manner as a diabetes patient treats himself with insulin. Injections may be made under the skin of the thigh, or, preferably, on the side of the abdomen, if applied by the victim himself. They should be given under the skin of the back, between the shoulders, if applied by some one else.

If the serum can be given at once or within the first hour or two after the bite, a portion of the syringe contents (2 to 3 c. c., for instance) should be given by subcutaneous injection locally around the bite. This tends to prevent local destruction of the tissues. In late-treated cases the local application is probably of little avail.

If medical aid is available, intramuscular injections are preferable in order to hasten the absorption of the serum, and in cases seen late and those in which the symptoms are severe, intravenous injection is advised.

*Dosage.*—As each syringe contains 10 c. c. of the antivenin, inject the entire contents in one dose. The relation of the age of the person bitten to the dosage is just the reverse of the usual rule for dosage. The amount of venom injected is the same whether a child or an adult is bitten. The smaller the individual the greater the need of the antivenin. The syringe contains enough antivenin to protect against the average amount of venom secreted at one time by North American serpents. Where there is reason to believe that the poison injected by the serpent was of unusually large quantity, or when the symptoms develop quickly and in severe form, as, for instance, in children, it is advisable to give a second, third, or even a fourth dose if indicated; that is, if the first has not caused the symptoms of poisoning to subside. In all cases the patient should be watched for three to five hours after every injection and if his condition has not improved within that time a second injection should then be made.

## INFECTIONS FROM SWIMMING

Swimming is naturally one of the most popular pastimes in which the men of the Navy indulge. It is, in many ways, one of the most beneficial also and should be encouraged. Unfortunately, it has its dangers, the greatest of which, for the qualified swimmer, is that of contracting sinus or ear disease. Efforts made to prevent trouble from swimming have been directed chiefly toward keeping men out of water which is presumably highly contaminated with bacteria and toward keeping even reasonably safe water out of the ear canals.

Modern swimming pools are so carefully controlled that there is small danger of the number of bacteria contained in their water reaching dangerous proportions. In spite of this, sinus and ear troubles continue to follow swimming in even the best of pools. Why this is so is discussed in a paper by H. Marshall Taylor, M. D., of Jacksonville, Fla., published in the Southern Medical Journal of March, 1928, under the title "Otorhinologic hygiene of swimming."

The author shows that all of the diving mammals are provided with some sort of an apparatus for closing the nostrils when diving, whereas man has only the remnant of such, the compressor narium, which is entirely inadequate for the purpose. This difference seems

to Taylor "* * * to explain why man is so susceptible to sinus diseases while the lower animals breathing air as man does and living constantly in the water do not encounter these same difficulties."

The breathing apparatus of man and diving mammals is practically the same and there is no difference between the two so far as the type of epithelium lining the respiratory tracts is concerned. The latter, however, have the power of protecting the epithelium from the water, while man has lost this power.

The author goes on to say that—

> Man when diving allows the inrush of water, possibly contaminated or * * * overchlorinated, to come in contact with his respiratory ciliated epithelium, destroying the protective mechanism of the nose, * * * (which) consists mainly of two factors: (1) The secretion of a mucus which is inhibitory to bacterial growth * * * and (2) the power of the ciliated epithelium to sweep this mucus, in which the bacteria become enmeshed, toward the pharynx and esophagus to be disposed of. Anything which interferes with these two functions, whether it is mechanical, chemical, or thermal, breaks down nature's barriers and renders the nasal cavity and its appurtenances susceptible to infection.

It has been shown that reduction of temperature or irritating chemicals will stop the wave-like motion of this ciliated epithelium. If the epithelium lining the proximal end of the eustachian tube does not function, infection may enter the tube and reach the middle ear.

The mucus is washed away in diving leaving the epithelium exposed to the action of the water and its contents, with consequent damage to the cells.

A second factor concerned in infection is lowered resistance, and this may be brought about by too long exposure to the water. Prolonged cold baths reduce the body temperature materially. The author, one summer, made a study of 250 children under 13 years of age, who were swimming in an indoor tank in which the temperature of the water was 73° F. After 45 minutes in swimming only 30 children had normal temperatures, while many of the others showed a reduction to 95° F.

Warm-blooded aquatic animals are adapted to life in cold water; man is not. In man the loss of heat incident to prolonged exposure to cold water can not be compensated for by increased heat production, so the body temperature falls. The animals living in cold water are protected either by fur or a thick layer of fat; man has no such protection.

As a result of his studies, Taylor concludes that there are several things which must be done in order to prevent aural and paranasal sinus infection following swimming.

First, chilling of the body surface must be avoided. No one should be allowed to use a pool for longer than 45 minutes, particularly an

indoor pool where the bathers are likely to lounge around on the cold tile a considerable part of the time.

A committee of the American Medical Association has recommended that persons with contorted nasal passages, hypertrophic turbinates, or a history of sinus trouble or "catarrh," be not allowed in the water. Adenoid obstruction, discharging ears, or perforated drums, contraindicate swimming. Some substance should be used to prevent water entering the external auditory canal.

Exhalation through the nose when the face is submerged; inhalation through the mouth when the mouth is exposed to the air, should be taught, even before lessons in diving and swimming are given.

The author feels that—

> The question of reducing infections of the ears and paranasal sinuses is a matter of educating the public in regard to it. The responsibility falls not only upon the sanitarians, public-health officials, and the otorhinologists; but this is an important phase of preventive medicine to which everyone in medicine, particularly the family physician, should lend his help and support.

## MALARIA IN THE TREATMENT OF GENERAL PARALYSIS

During the past 4½ years 251 patients with general paralysis have been given the malaria treatment at the New York State Psychiatric Institute, Wards Island, N. Y. Report of the results of this treatment in 156 male patients has been made by H. A. Bunker, jr., and George H. Kirby, and published in the Medical Journal and Record of February 15, 1928.

That which gives this report its greatest importance is the length of time these patients have been under observation. Sufficient time has elapsed to allow some opinion to be formed as to the permanency of the results of treatment.

Only the summary of the paper, which follows, will be given.

> 1. Of 156 male patients with general paralysis who received the malaria treatment between June 1, 1923, and August 1, 1927, at least 50 per cent manifested a definitely favorable response, even though in one-third of these latter residual evidences of previous cerebral tissue destruction precluded full recovery in a clinical sense.
>
> 2. In this group, observed over an average period of 2½ years, the death rate due to general paralysis has been 12.5 per cent; based on the average expectation of life of 1.5 years exhibited by untreated general paralytics in the New York State hospitals, the death rate in the present group would have been at least 65 per cent.
>
> 3. Of thirty-four patients treated more than 3½ years ago (prior to June 1, 1924), 29 were alive three months after the completion of their course of fever: of these 29, 5 have since died, 6 are unimproved (although only one of these has definitely retrogressed), 2 have remained moderately improved, and 16 attained full remissions; in 14 of whom their state of complete clinical remission has thus far continued unaltered.

4. In a group of 84 cases, 12 out of 16 patients of the manic or hyperactive type achieved full remissions, as compared with 11 out of 20 of the expansive type, but only 7 out of 48 of the simple dementing type who did so.

5. In a group of 47 patients followed for at least 2½ years, the malaria treatment had little or no influence upon the strength of the Wassermann reaction in the spinal fluid in 26 (55 per cent). But in 10 patients (21 per cent) the Wassermann reaction has become completely negative (to 1 c. c. of spinal fluid) following upon treatment with malaria alone.

6. Two years was more or less the minimum period of time required by the majority of cases to attain at least the higher degrees of modification of the Wassermann reaction in the spinal fluid.

7. Since advantage can now be taken of a form of treatment demonstrably effective against a disease which has largely resisted the therapeutic methods of the past, the early recognition of neurosyphilis of the parenchymatous type becomes mandatory.

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## ETIOLOGY OF PERNICIOUS ANEMIA

At the meeting of the Southern Medical Association in November, 1927, Seale Harris, M. D., of Birmingham, Ala., delivered the chairman's address before the Section on Gastroenterology. This has been published in the Southern Medical Journal, February, 1928, under the title, "The etiology of pernicious anemia: is it secondary to hepatic retention, resulting in deficiency of a liver endocrin (antihemolysin)?" Doctor Harris's paper discusses the subject so adequately that it would be well if all could read it in its complete form. For the benefit of those who can not do so, an extensive abstract will be given.

The paper begins with a comparison of the control of pernicious anemia by a liver diet or the use of liver extract or "fraction" with the control of diabetes by insulin. As, in diabetes, the hyposecretion of insulin is frequently caused by a destruction of the cells of the islands of Langerhans, may it not be that the essential etiological factor in pernicious anemia is "primarily a hypofunction of liver cells which secrete an endocrin that controls erythrocytolysis?" asks Harris.

Autopsies on patients who have died of pernicious anemia usually show degenerative changes in the liver. Perroud, in 1869, advanced the theory that pernicious anemia is due to fatty degeneration of the liver. According to Harris, however, "Studies are not complete enough as yet to identify any of the particular liver lesions as the *sine qua non* of pernicious anemia causation, but the frequency of such relationship is suggestive."

The infectious theory of the etiology of pernicious anemia has been frequently advanced. Hunter, in 1887, thought that some organism produced a toxin which was absorbed and caused hemolysis of the

red blood cells in the portal venous system. Harris now thinks that the portal system is the point of entry, but disagrees with Hunter as to the specificity of the organism and the way in which it acts. Several observers have advanced the theory that *B. welchii* is the cause of pernicious anemia, but of this there is no proof. More recently, Wood has sought to show that *Monilia psilosis* may be one of the causes.

Harris thinks it possible that pernicious anemia may result when the monilia localizes in the liver, just as sprue results when it localizes in the pancreas. He does not say, however, that the monilia is the specific organism for pernicious anemia or sprue, but considers it likely that other factors are concerned in the etiology of both.

The author reports the development of pernicious anemia in a patient with pellagra, and suggests that these two conditions might have the same etiology.

That there may be a relationship between gall bladder infections and pernicious anemia seems to have been established by Jones and Joyce, who "observed the association of gall bladder infections with pernicious anemia in a number of patients in whom improvement of the anemia followed cholecystectomy." These and other surgeons have found pathological changes in the liver at gall bladder operations. Harris says:

> Of course, every case of hepatitis is not followed by pernicious anemia any more than is every case of pancreatitis followed by diabetes. But the patient with a chronic gall bladder disease may be regarded as carrying an infection that may ascend into the liver and finally result in pernicious anemia. Therefore, the surgeon in performing a cholecystectomy in chronic gall bladder disease may remove the focus of infection of a hepatitis which might destroy the cells that secrete the antierythrocytolitic endocrin.

As to the relationship between achlorhydria and pernicious anemia, Harris, in the conclusions of his paper, says:

> There may conceivably be two different relations * * *, a concomitant one and a contributing one. In the former, achylia gastrica has no etiological relationship to pernicious anemia, but is a concomitant condition resulting from a common infection of the stomach and liver which precedes the disease. Again, the achlorhydria may antedate the anemia for several years, in which instance the loss of antiseptic efficiency of the gastric juice may permit the entrance of pathogenic organisms into the duodenum, biliary passages, and liver, with a resultant hepatitis, followed by an erythrocytolytic endocrin imbalance.

The liver, acting, as it does, as a filter for the portal system. is peculiarly liable to injury by infection or toxins. These, acting over a long period of time, may injure the liver in such a way as to result in cirrhosis, amyloid change, or, possibly, an interference with the red blood cell regulating mechanism, which results in pernicious anemia.

Harris suggests that—

The substance formed in the liver which inhibits the hemolytic function of the reticulo-endothelial cells might be called antihemolysin, or antierythrocytolysin, until something definite is known of what it is, or of which hepatic cells produce it. If there exists a deficiency of this substance, the secretion of the hemolysin by the reticulo-endothelial cells would be uncontrolled and pernicious anemia would result. Feeding liver, or the administration of a liver extract containing the substance, would supply the needed endocrin for controlling hemolysis, thus attaining the desired stabilization of the number of red blood cells in the circulation.

On the other hand, Harris considers that an excessive secretion of the substance would reduce red blood cell destruction and produce polycythemia. He reports a case which seems to justify his belief.

It is probable that the spinal cord changes which occur in pernicious anemia are not related to the blood changes, but are due to the same pathogenic agent. The anemia is relieved by liver diet; the other changes are not. Therefore, it is reasonable to suppose that all are part of a toxic or infectious process, and that "in this sense pernicious anemia is not a primary anemia, but a secondary one."

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## IMMUNITY IN YAWS

Otto Schobl, M. D., of the Bureau of Science, Manila, published in the Journal of the Philippine Islands Medical Association, January, 1928, a paper entitled "Immunity in yaws." As yaws and syphilis are considered by many to be identical, it has special interest for the naval medical officer, who sees much of both conditions.

Experiments were conducted with monkeys, in which the course of experimental yaws is summarized by the author as follows:

Following intradermal inoculation of yaws material into monkeys, there is a period of one month of incubation. During this time no clinical or serological changes occur in the animals. Toward the end of the second month the treponemas multiply considerably and the whole lesion, having remained superficial up to this time, then penetrates into the deeper layers of the skin. Between the third and the fifth months the infection gains the upper hand. Local exacerbation of the local yaw occurs during this period. Metastatic generalization takes place between the third and the fifth months and the Wassermann reaction becomes stronger the nearer the infection approaches the fifth month.

As far as the Philippine monkeys are concerned, the infection runs in three types. The first type is a local yaw only; the second, a local yaw followed by a generalized metastatic yaw, so-called secondaries without tertiaries; the third form, a local yaw without metastatic yaws (secondaries), followed by ulcerative tertiary lesions, or late framboesides.

Schobl was the first to produce these three clinical types experimentally and to study the immunity that results from them. He found that in monkeys experimentally infected with yaws and super-

infected every month, inoculation is invariably followed by the development of yaws up to the fifth month of the disease. Of the animals inoculated in the sixth month, some developed infection and some did not; while in the seventh month and later, no infection followed inoculation. This immunity was shown to last for at least 2½ years and is probably lifelong.

These experiments were conducted with monkeys which developed only the local yaw.

Next, the author studied the effect of treatment upon the development of immunity and found that "* * * animals treated within the first two months of infection and reinoculated in the seventh month of the infection would again develop a yaw as a result of inoculation, while animals treated in the third, fourth, fifth, and sixth months of infection proved to be immune."

In the case of those monkeys which developed generalized yaws or tertiaries, immunity developed differently. Secondaries developed between the third and fifth months of infection. When these appeared, immunity was complete. Those animals that developed tertiaries became immune much later.

Schobl says:

> There is, therefore, this to say in summarizing our findings on immunity in monkeys, namely, that the immunity develops slowly, begins to develop from the third month on, and is fully developed in the seventh month in the case of local yaw. It develops rather suddenly and sometimes early in generalized yaws (so-called secondaries), while in tertiary yaws, that have not gone through the secondaries, the immunity, is much delayed. Our supposition is that immunity develops from the third month on, on account of the penetration of the yaws process into the deeper tissues and the simultaneous multiplication of the treponemas. If this be true, then it must be possible to immunize animals without the production of either local, generalized, or tertiary yaws by placing the treponemas from the beginning in the deeper tissues of the skin; in other words, immunization against yaws ought to be possible by paradermal inoculation.

That monkeys can be immunized against yaws by paradermal inoculation was demonstrated by Schobl. A series of monkeys was given four subcutaneous injections of *Treponema pertenue* within five weeks and failed to develop any yaws lesion. Inoculation of one animal one week after the last injection resulted in yaws, but all inoculated four months after the first injection proved to be immune.

According to the writer, these experiments show that the immunity is developed in the deeper tissues and not in the epidermis.

The immunity, apparently, resembles that following smallpox vaccine, and not that following bacterial infection. The development of immunity does not influence the healing of lesions already present;

nor should it be expected to do so, since the blood and lymph contain no treponemicidal properties.

Schobl compares the infection and immunity in monkeys and in man. He found that, while the incubation period is about the same, the duration of the generalized infection in monkeys is much shorter. The "immunity develops in man with generalized yaws about as early as in monkeys with local yaw, and a little later than in monkeys with generalized yaws."

Further investigations are being carried on by the author, who concludes this paper with some interesting speculations.

Since earlier and more complete immunity occurs in animals that have gone through the secondary stage of yaws, would it not be wise to delay treatment in treponematous infections (yaws and syphilis) for six months or so, and allow immunity to be built up? If vaccination against these diseases should be found practicable on humans, would it not be wise to vaccinate those already infected in order to hasten immunity and prevent the late manifestations? Would it not be well to vaccinate all those people who habitually expose themselves and thus make up the largest source of infection?

As the author says:

> This may sound Utopian and it is too early to say whether or not these suggestions should be seriously considered; but those of us who have been in contact with developments in medicine during the past 30 years have experienced innovations undreamed of 30 years ago. So, who knows but that what seems to be phantasy to-day may not become a matter of daily practice in the future?

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### BITES AND STINGS

Whether or not the bite or sting of a certain insect, spider, or other arthropod will result in serious injury, is a question always of interest and often of great importance. The fear of the scorpion and tarantula is almost universal and many are the stories told of fatal effects having followed their stings and bites. The truth of these stories is hard to ascertain.

During the past four years, H. E. Ewing of the United States Bureau of Entomology has been conducting experiments to determine the harmfulness or harmlessness of some of the more common arthropods. The results were published in the American Journal of Tropical Medicine, January, 1928, under the title, "Observations on the habits and the injury caused by the bites or stings of some common North American arthropods." The subject discussed is of such interest that an unusually complete abstract of the report will be given.

The arthropods studied and reported upon were: (1) The common striped scorpion; (2) the vinegerone, or giant whip-scorpion; (3)

the common tarantula of the southwest; (4) a tarantula of the genus *Pamphobeteus;* (5) the common eastern trapdoor spider; (6) several Lycosa (common spiders); (7) the black widow; (8) the house centipede; (9) the giant water bug; (10) a bug of the family Nabidae; and (11) bees. These will be taken up in the order given.

### 1. *The common striped scorpion*

This scorpion, *Centruroides vittatus* (Say), is found in the Southern States, as far north as Virginia and Missouri and as far west as western Texas. Its usual habitat is under the bark of logs, under logs lying on the ground, and under piles of brush and dead leaves. It is also found under the flooring of out buildings and piles of lumber and wood. It frequently invades dwellings.

At 9.12 one morning the writer allowed a specimen to sting him on the back of an index finger. There was an immediate burning sensation. Soon the finger became numb and in 15 minutes there was slight swelling. At 12.50 the condition of the finger was normal except for a slight numbness.

Later in the day the same scorpion was made to sting another person. Approximately the same degree of injury was inflicted.

The author says: "These two simple experiments indicate that the sting of this common scorpion of the Southern States is but little if at all more serious than a bee sting. * * *"

### 2. *The vinegerone, or giant whip-scorpion*

This scorpion, *Mastigoproctus giganteus* (Lucas) is found in Florida. Other species are found in the Southern States, Mexico, and tropical America. The whip-scorpion lives very largely upon the ground or burrows into it.

It is this scorpion which is so much dreaded by ignorant persons, but morphologists state that it has neither sting nor venom and is harmless. The author allowed a specimen to bite him. There was no pain at any time except when the scorpion was actually biting, and in 25 minutes the skin and flesh were normal.

The writer and other people were bitten by this scorpion on other occasions. There was never anything "more than a trivial mechanical effect, similar to that of a slight pin prick."

### 3. *The common tarantula of the Southwest*

The largest and best known of these is *Eurypelma californica* (Ausserer), which is found in California, New Mexico, Texas, and a few other States. It lives upon the ground in small holes. It is very sluggish unless aroused, when it rears on its hind legs and strikes with its fangs.

A full grown specimen was kept for several years in the Bureau of Entomology, during which time it was handled by many people. Only once did it bite anyone. A lady was bitten on the tip of the second finger at 4.03 one afternoon. At once a drop of blood collected and blood continued to flow for a few minutes. The pain was considerable and lasted for about one hour. Apparently, it was entirely due to mechanical injury.

### 4. *A tarantula of the genus Pamphobeteus*

Attempt was made by the writer to simulate the bite of this tarantula. He chloroformed one and removed a fang together with its poison sac. The fang was forced into the forearm, but no poison was ejected. Then a drop of poison was squeezed out and placed in the puncture made by the fang and the fang was again forced in until blood came. There was much smarting at the puncture, a wheal developed in a few minutes, and a reddened area appeared after about 20 minutes. After an hour the smarting was very slight and the swelling had disappeared. After four hours there were no effects of any kind.

Of this arthropod, Ewing says: "Injury from the bite of this tarantula would probably be not serious. However, if a large amount of venom were injected into a small child much pain and discomfort would probably be produced."

### 5. *The common eastern trap-door spider*

The name comes from the hinged lid with which these spiders cover the silk-lined holes in the ground in which they live, and from which they emerge only at night. The spider is a common one in the southern part of the United States. The specimen used in this experiment was a female of the species *Pachylomerus audouinii* (Lucas). She was allowed to bite the author at 2.55 p. m. The pain was no more than a pin prick. One hour and five minutes later the condition of the finger was approximately normal, and the next day was entirely so.

This species is dismissed by the author with the following statement: "Although this trap-door spider belongs to the tarantula-like group of spiders and is larger than some of the tarantulas, its venom is of less potence than that of many common web-spinning species. It is a species in no way to be feared."

### 6. *Lycosids* (*common spiders*)

A common large spider—*Lycosa carolinensis* (Walckenaer)—was captured by the author in his garden. As he was unable to make it bite him, it was chloroformed and its fangs removed. One fang was

thrust into the forearm for its full length. In two minutes there was slight smarting and numbness. Seven minutes later considerable pain was noted and there was slight swelling about the puncture. Twenty minutes after the fang was inserted it was removed and the pain soon began to subside. Within two hours the skin was normal and the pain was very slight.

A very large specimen of *Lycosa punctulata* (Hentz) bit the author on the finger. The wound made was so small it could not be seen with a hand lens. Very slight smarting continued for about half an hour.

A spider of *Lycosa* species buried both fangs in the ring finger of the author. The pain was intense for a short time, but in 10 minutes most of it was gone and in half an hour conditions were normal.

### 7. *The black widow*

*Latrodectus mactans* (Fabricius) is considered the most poisonous species of spider in America. Baerg, in 1923, allowed himself to be bitten by a mature female. That the results were serious is shown by the observations made by his attending physician, which are quoted by Ewing as follows:

> The toxicity was also manifested by vasomotor changes in the lumbar muscles and muscles of the extremities, and in all the large joints of the body, as was shown by intermittent pains and symptoms similar to intermittent claudication. There also seems to be a disposition on his part to unload very slowly, by elimination, the products of poison. More so than is the case with bites of any of the snakes, including the rattler, that I have observed.

The black widow is found throughout the United States, but is more common in the Southern States. It lives under logs and stones and in cracks and crevices, and in outbuildings and basements. The mature female is about 7 to 9 mm. in length. It is black, except for a red spot, shaped like an hour-glass, on its abdomen. Other spots may be present on the upper surface of the abdomen.

The poison sacs of *Latrodectus mactans* are very large—about 2.75 mm. in length and 1.08 mm. in circumference.

Ewing says:

> The poison or venom of *Latrodectus mactans* is a silghtly viscid, transparent fluid, with a slight suggestion of bitterness in its taste when diluted with distilled water. * * * The entire contents of one poison sac of a mature female were dissolved in about 3 c. c. of distilled water and taken to a chemist for testing for acidity. Indicators delicate enough to detect a thousandth per cent deviation from neutrality failed to give any test.

Experiments to determine the toxicity of the venom on man were made.

In the first test the back of the forearm was pricked with a sterile needle until bleeding resulted. A drop of the diluted venom was placed over the wound and rubbed in at 1.36 p. m. At 2.02 note

was made that deadening and burning pains were felt at point of wound and had been coming and going about every minute. At 2.15 a sore area around point of injury was noted; there was dull pain in the forearm, and the skin was slightly reddened. At 2.18 there was slight paralysis at the wrist. At 2.36 pain in shoulder. At 2.45 dull pain throughout whole arm was noted. At 4.10 the condition was normal.

In the next test, 8 cubic millimeters of the aqueous solution of the venom was injected into the left forearm at 3.52 p. m. Ten minutes later it was noted that there was a slightly whitened swelling about the puncture. It was likened to the swelling which follows a bee sting, but was not so large and there was but little pain. At 4.19 papules appeared about needle puncture. Burning sensation came on. At 4.56 the author made this note:

> The lower part of the arm is somewhat numbed, and there is a dull deadening pain in most of it. Wheal is small. Surface of skin about needle puncture moist with sweat. The small papules about the central wheal give the skin the appearance of goose flesh and suggest a condition found following poisoning from poison ivy, yet the entire local effect produced by injecting the *Latrodectus* venom is quite different from the effect produced from ivy poisoning. After the spider venom had had time to act I found it rather hard to use the fingers of the hand freely. They were not paralyzed but were numbed and responded somewhat in a manner similar to that observed when the hand has been exposed to severe cold weather. The effect was a numbing rather than that of paralysis.

By 9.54 the pain was slight. The author slept well during the night although there was some pain in the forearm until he went to sleep. In the morning there was no pain, but the moist area was still present and there was some itching. The next evening some pain returned. On the second day there was some itching, and the moist area persisted for several days.

Ewing compares the results of his experiments with the results of Baerg's bite by the *Latrodectus* in this manner:

> * * * In the hypodermic injection much less than 1 per cent of the amount of venom necessary to fill completely one of the poison sacs was used, yet many of the symptoms produced were almost identical with those that follow the bite of the spider. The effect on the nervous system and the pain produced were much less than reported by Baerg. But in both instances the injection of the venom was slowly followed by the formation of a whitish wheal about the puncture point; in both cases there were recurrent shooting pains; and most characteristic of all, in both experiments a persistent moist area formed about the injury point and lasted a long time. In the case of the writer's experiment the area was sticky. It was apparently formed by a sweating process which left a sticky residue. Long after all other symptoms were gone this moist, sticky area remained.

A third experiment was undertaken, in which a fang of an adult male spider was thrust into the skin and the poison sac squeezed.

The results were slight, although there was a transient, intense pain. The writer concludes from this that the male was almost devoid of poison.

8. *The house centipede*

*Scutigera forceps* (Raf.) is found throughout temperate North America. It is considered harmless by entomologists, but is dreaded by many persons. Its habits are well known.

A full-grown specimen was induced to bite the writer on the hand. There was slight burning, which continued for a few minutes, and a small wheal developed in eight minutes. The next morning the only indication of a bite was a minute red speck.

Ewing says that the fears of this centipede are groundless. Its jaws are so weak that it can hardly penetrate the skin with its fangs. Where serious results have followed its bites, they are probably due to infection.

9. *The giant water bug*

Of the bites of this bug the writer says:

When *Benacus griseus* bites it emits a milky fluid from the tip of the beak. And the beak adheres to the skin after penetration, so that the skin is pulled up when the beak is withdrawn. Judging from these observations the bite of *Benacus griseus* is rather painful, and the effects are more than transitory, yet they are hardly to be considered serious.

10. *A bug of the family Nabidae*

A bug of this family bit the author when he was working in his garden. The sensation was similar to a mosquito bite, but when feeding was interrupted the area around the bite looked like that which follows a bee sting. The smarting soon stopped and the swelling disappeared, only to return two days later, after which it slowly subsided. So far as the author knows this is the first report of a man being bitten by this bug, *Nabis rosipennis* (Reut.).

11. *Bees*

Bee stings are too common to require much comment. It is of interest, however, to learn from an authoritative source that yellow jackets—*Vespula germanica* (Fabricius)—sometimes do and sometimes do not leave their stinger in the puncture made in stinging, and that it is questionable whether or not tolerance may be acquired to bee stings.

Thus it is seen that many of our most dreaded arthropods are in reality comparatively harmless creatures, and that, except in the case of *Latrodectus*, no fears of serious consquences need be felt following

their sting or bite. The treatment, therefore, need consist only of measures to relieve pain and prevent infection.

The black widow—*Latrodectus mactans*—is probably the only really poisonous spider found in North America, and its bite may result seriously.

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### SPINAL PUNCTURES

A question was recently raised concerning the advisability of performing routine spinal puncture for diagnosis and as a check on the results of treatment.

The advice of certain experts (Doctors White, Freeman, Fong, and Ziegler) at St. Elizabeths Hospital, Washington, D. C., was sought. The consensus of opinion of these psychiatrists follows:

"(*a*) A spinal puncture for preliminary diagnostic purposes is always justified and should be routinely practiced in all neurosyphilitic cases. There are numerous cases in which the blood may be negative to Wassermann and Kahn tests but which may show spinal fluid changes. A contraindication would be a suspected tumor in the region of the basal ganglia.

"(*b*) The joint experience of the foregoing has been that no serious accident has resulted from spinal puncture, though in a fair percentage of cases a very disagreeable and distressing headache occurs. Such headache is usually prevented by the use of a small-caliber needle and by insistence on absolute quiet for 12 hours succeeding the puncture.

"(*c*) Frequently repeated punctures are unnecessary and meddlesome, since changes in the spinal fluid are slow, and even with the malarial treatment no change of consequence is expected within a year. Arbitrarily it might be said that three spinal punctures within a year are sufficient to determine the progress of treatment in any individual case. Of course, in the Swift-Ellis treatment and in such cases as those in which spinal drainage is tried, more frequent punctures must be done, but the present opinion is that these methods of treatment have no great value.

"(*d*) A spinal puncture is always a disagreeable proceeding to a patient who is not actually paretic. There are the anticipation, the actual puncture, and the after effects to be considered. A lot depends upon the one who does the puncture, but even to the expert some are done very easily and others may be very difficult indeed to accomplish. For all these reasons punctures should be kept at a minimum, but no one should ever hesitate to perform a lumbar puncture for preliminary diagnostic reasons."

## NEEDLE-HOLDING DEVICE

When a large number of persons are to be given toxin-antitoxin, antityphoid, or other inoculations, caring for the needles frequently presents a difficult problem.

Health News, the weekly publication of the New York State Department of Health, in its issue of February 27, 1928, contained a description of a simple device which will be a real aid in solving the problem.

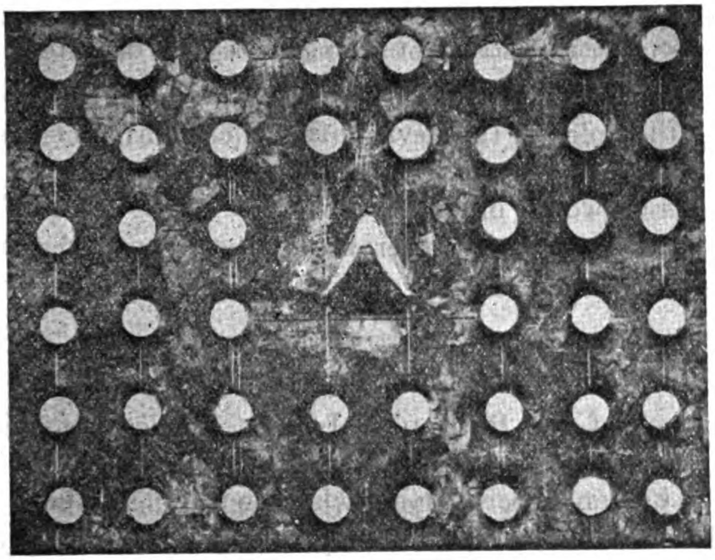

FIG. 1.—Needle-holding device

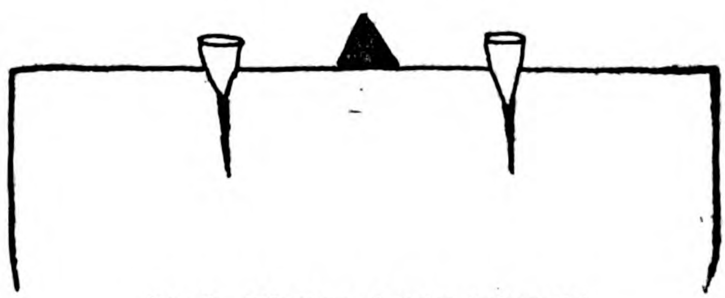

FIG. 2.—Side view of device (schematic)

The New York State Department of Health has generously consented to our republishing the description of the device and has supplied us with the plate of the illustration which accompanies it.

A cheap but satisfactory needle holder for use in toxin-antitoxin clinics has been devised by Dr. C. R. Hervey, district State health officer. A set of three can be made by any tinsmith for $1.

Each holder is made of a 5 by 4 inch sheet of galvanized iron, the two ends of which are bent at right angles to give the desired elevation, and 44 holes three-eighths inch in diameter are drilled through the remaining section. In the

center an angular cut is made, allowing a projection to be raised, which may be used for a hook in lifting the holder out of the sterilizer. (See illustration.)

In use, while one holder filled with needles is being boiled, the second, already sterilized, is provided for the use of the physician at the table where the injections are being given, while the third is availab'e to receive used needles.

The size of the holes is important, the ones described being for an ordinary five-eighths-inch hypodermic needle.

By the use of the holders needles are kept in orderly array, the physician knows just how long each needle has been boiled, each needle can be "speared" by the nozzle of the syringe without handling, the operator is presented with 44 need'es at one time instead of with 1 needle at a time, and the accuracy and celerity in exchang'ng needles between inoculations is so much increased that the necessity for the services of one nurse may be eliminated.

In a personal letter Doctor Hervey calls attention to the necessity for making the holes in the device of such circumference as to cause them to embrace the shoulders of the needles. This will prevent wobbling, which would interfere with the "spear" aim of the operator. The size desired will, therefore, depend upon the size of the needle used.

## LEPROSY

The Journal of the Philippine Islands Medical Association for February, 1928, contains three valuable papers on leprosy. These are all from the Culion Leper Colony, which is the place above all others in which leprosy in all its phases may be studied with profit.

"Evaluation of the results of treatment of leprosy with the chaulmoogra derivatives" is the title of the paper by C. B. Lara, M. D., chief physician of the colony. Doctor Lara shows that as a result of the use of these drugs during six years 589 negatives have been paroled or discharged, whereas only 47 cases were paroled in the 15 years preceding. Negative cases to the number of 39 have died in the colony and there are 257 still under observation, making a total of 885—approximately 16 per cent—apparent cures. Not enough time has elapsed to justify speaking of absolute cures, but after two years the incidence of relapse has been low, probably not more than 5 per cent. This author sees no reason why complete cure may not take place if treatment is continued long after all active signs of the disease have disappeared.

Eloy V. Pineda, M. D., of the pathological section of the colony, writes "On the persistence of *Mycobacterium lepræ* in the negative leper" and shows that in 10 out of 11 negative cases which came to autopsy, smears from the deeper organs showed the bacteria as still present, and in 9 out of 53 cases the organism was found in smears of material aspirated from the femoral lymph nodes. In other words, so-called negative cases are not necessarily bacillus free. Experience

has shown, nevertheless, that "most of the cases that have developed sufficient resistance to become negative and to remain so for two years will continue to hold the organisms in check, if not overcome them entirely." Again, the wisdom of continuing treatment long after symptoms have disappeared is made evident.

Doctor Pineda is also the author of the third paper, "The Presence of *Mycobacterium lepræ* in the placenta and umbilical cord." Of 107 placentas examined 57 were found positive. In 25 cases the organism was found in the cord blood. No pathological changes attributable to leprosy were found in the placenta or cord. The bacillus reaches the fetus in many cases and intrauterine leprosy must be considered a possibility.

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### THE STANDARDIZATION OF THE RÖNTGEN-RAY DOSE

So much attention and talent is being focused on this extremely important and difficult phase of Röntgentherapy that the paper of Glasser and Portmann, published in the American Journal of Röntgenology and Radium Therapy, January, 1928, assumes more than passing interest. Another paper by Glasser, Portmann, and Seitz in Radiology, April, 1928, discusses practically the same subject, and is of equal interest.

There is described in these papers a new and simplified Röntgen radiation intensity measuring instrument of the ionozation type. The authors claim unusual ruggedness, simplicity, and accuracy for the instrument; provision is made for checking constancy of calibration with radium. They attempt to reestablish the electrostatic unit as the Röntgen dose (R) unit.

The principal interest in these papers centers on the standardization of the unit of Röntgen dosage. The authors claim to have established a close relationship between their proposed R unit and the electrostatic unit of Duane and of Bachem, and the French unit of Solomon. They have not been able to establish a satisfactory relationship between their unit and the German unit proposed by Behnken. This is attributed to faults in the German instruments used to transport the German R unit to this country. They expect to overcome these faults in the near future and hope to establish a definite relationship between their R unit and that of Behnken.

In view of the forthcoming Second International Congress of Radiology at Stockholm in July, it is suggested that these papers are most timely and of unusual interest to Röntgentherapists since they offer a definite basis for the preliminary definition of an international Röntgen unit.

## THE USE OF ANTISPASMODICS IN THE RÖNTGEN EXAMINATION OF THE GASTROINTESTINAL TRACT

Homes and Dresser, of the Department of Röntgenology, Massachusetts General Hospital, report in the American Journal of Röntgenology and Radium Therapy, January, 1928, the results of their experiments with the use of the nitrites as antispasmodics in the röntgen examination of the gastrointestinal tract. They also compare amyl nitrite with atropine for this purpose. They believe that amyl nitrite is equal to atropine as an antispasmodic and has the advantages of simplicity of administration, decidedly less discomfort to the patient, less probability of untoward effects, and, because of the immediate action, repeated examinations are usually unnecessary.

The most significant conclusion drawn from their investigations is the inconstancy of results and the difficulty of proving the diagnosis by the use of any antispasmodic. They believe that antispasmodics can not be used as diagnostic criteria. This opinion has considerable significance, since it has been generally accepted by röntgenologists that in those cases where spasm of the stomach is relieved by an antispasmodic there probably was no lesion, and vice versa. The authors report several cases in which spasm was controlled by amyl nitrite, but subsequent surgical interference revealed lesions in the spastic area.

They have found amyl nitrite of considerable value in the study of the irritable, spastic type colon.

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## THE PATHOLOGY OF INFLUENZA

A comprehensive review of the pathologic anatomy of influenza, by Franz Lucksch, M. D., professor of pathologic anatomy in the German University in Prague, was published in the March, 1928, number of Archives of Pathology. As the author states, the review is based chiefly on German sources, but the findings are applicable to the disease as it manifested itself during the recent epidemic in this country.

Only the summary, which follows, will be given.

> In summary it may be said that the anatomic changes in the last epidemic of influenza differ from those in former epidemics mainly in their seriousness; that is, quantitatively. In this respect, I may point to the changes of the respiratory tract and its appendages (pleura) and to the grave changes in the nervous system, the toxic injuries that manifested themselves, especially in the vascular system. The pathologic-anatomic changes during the last epidemic differed, however, from those in the former epidemics, not only quantitatively, but also qualitatively. Of the changes that are qualitatively different may be mentioned the pseudomembranous inflammations of the respiratory passages and the metaplasia of their epithelium. The latter changes especially had not

been recorded before. Regarding the bacteriologic observations, cautious mention is made of the participation of staphylococci in purulent processes of the lungs as something different from what occurred in former years. Anatomic changes of the digestive system were found still less frequently than before, if possible. A further peculiarity of the last epidemic seems to be Zencker's degeneration, which was frequently observed in the rectus muscles. The most striking phenomenon of the last epidemic—besides the great mortality—is the frequent and grave participation of the central nervous system in the disease. Among these nervous changes, the chronic or so-called residual phenomena apparently have no predecessors of equal significance and frequency in former epidemics, at least not in the striking and oft-repeated picture of parkinsonism and of the vegetative disturbances associated with it.

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### ALCOHOL DEATHS

The New England Journal of Medicine, March 22, 1928, reports the results of tests made by Drs. Reid Hunt, George H. Bigelow, and others to determine the toxicity of illicit liquor in Massachusetts and the substances responsible for this toxicity.

Animal experiments were carried on by Hunt with 100 samples. He found that the toxicity depended entirely upon the content of ethyl alcohol and that no sample contained any substance more poisonous than this. Six samples contained methyl alcohol, but in such small amount as not to increase their toxicity.

As Bigelow says, " * * * Ethyl alcohol, then, is, has been, and always will be a poison which can not be tolerated by the body in excess, and in the vast majority of cases 'alcohol deaths' in Massachusetts are apparently due to excessive use of 'good pure alcohol.'"

Undoubtedly the same holds true elsewhere.

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### RUNNING WATER IS NOT ALWAYS PURE

With a persistence which entitles it front rank among hygienic fallacies, the idea has long clung to the popular mind that running water, if not always pure, will at least purify itself "in a dozen miles or so." Disastrous consequences following too literal application of this erroneous principle to the selection of municipal water supplies has prompted numerous scientific investigations both here and abroad. A critical review of these researches with a bibliography of over 170 references is given in Part I of a publication entitled "The Oxygen Demand of Polluted Waters" recently issued by the United States Public Health Service as Public Health Bulletin No. 173. Part II of the same bulletin is devoted to the presentation of an extensive series of experiments conducted in the stream-pollution laboratories of the Public Health Service.

Briefly, it may be stated that a water contaminated with the organic matters found in sewage and in various industrial wastes does gradually rid itself of such pollution, if allowed free access to air. Early studies of this phenomenon of self-purification led to the abandonment of a plausible theory based on the direct action of oxygen on the organic matters, and subsequent research extending over the past 50 years has revealed that the self-purification of streams is essentially a biological process. In this sense, the oxygen contained in aerated or running water does not operate as a sterilizing agent, as once believed, but rather as a neutralizing or deodorizing agent for some of the gases resulting from the bacterial decomposition of the organic matters. Dissolved oxygen is also required for the maintenance of fish life. While thus relegated to a secondary rôle, the amount and rate of disappearance of the oxygen which is contained in a given water nevertheless serves as an excellent indicator, first of the threatened disappearance of fish life and, with increasing pollution, as a warning of impending nuisance conditions. With the understanding that a bacteriological examination is a much better index of wholesomeness or fitness for drinking purposes, it has accordingly become customary to express the pollution of a given water in terms of its demand for dissolved oxygen when reference is made to the threatened disappearance of fish life or to the approach of nuisance conditions.

On the basis of extensive series of observations presented in Part II of Public Health Bulletin No. 173, it has become possible to give numerical expression to the actual rate at which the oxygen demand of a water is satisfied. The outstanding feature of this section of the report is that the rate at which the organic matter is oxidized, while strikingly uniform with a variety of waters, is exceedingly slow. Thus, in a given experiment with Ohio River water collected at Cincinnati, oxygen continued to be used up for fully 300 days and bacteria of intestinal varieties persisted for almost that length of time. Even in the absence of intervening pollution, it would be necessary to allow for a stream flow of several hundred miles before a water, once polluted, could regain its pristine purity. Irrespective of distance from the nearest upstream point of known pollution, it may be safely stated that no river in the United States can now be regarded as hygienically safe without treatment. Conversely, the possibility that a water polluted with sewage might be fully purified by flowing for "a dozen miles or so" becomes too remote for serious consideration.

From a more technical angle, the bulletin under discussion includes data relating to the rate of deoxygenation of polluted river water from which the velocity constants and the temperature coefficient of the underlying biochemical reaction have been computed by the least-

squares procedure. The orderliness with which the reaction proceeds compares favorably with that of the purely chemical reactions thus far reported in the literature. This constancy of the rate of deoxygenation of polluted waters is also borne out when the oxygen demand values obtained at various cities are referred to a per capita basis. For the average community, the amount of oxygen required each day for the stabilization of its carbonaceous wastes will be in the neighborhood of 100 grams (0.22 pound) per capita. The findings in this respect are of especial significance, inasmuch as they indicate the possibility of making fair estimates of the ability of a stream to withstand pollution without giving rise to offensive conditions by a calculation based solely on the contributing population and the volume of stream flow, and without resort to expensive laboratory investigations. Similarly, it would appear possible to estimate the minimum requirements in regard to the treatment of community wastes for the purpose of relieving existing nuisance conditions. The per capita oxygen demand figure also enters into several other sanitary engineering computations.

The bulletin concludes with four appendices dealing with analytical and statistical methods of procedure.

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### MEDICAL RECORDS

The very mention of the words " medical records " makes many of us shudder with a feeling of annoyance, a never ending annoyance. The Hospital Corps man prods us to get an entry made in order to complete his office or ward records; the bureau sends us letters reminding us that our records are lacking in necessary data; the Pension Bureau asks us pertinent questions—years after the occurrence—about ommissions of facts or transpositions of anatomical parts; the Veterans' Bureau wants to know why record was not made of a certain injury to a toe or finger, which the claimant asserts happened on a certain date and, furthermore, he produces affidavits from his shipmates that such an injury did happen and was treated at the sick bay. When these things occur we have an uncomfortable feeling that we have been remiss in our duties, but what can we do when the injury happened years ago and we have no remembrance of it? Simply write and say it must be on record in the bureau!

Possibly there are few of us who realize that our standing in the Medical Corps is greatly influenced by the manner in which we keep our medical records. The commanding officer is influenced—if only subconsciously—by the way the medical records are kept by the various medical officers. The officer who keeps his records in a neat, concise, accurate manner is, as a matter of course, rated higher than the officer who allows his medical records to be kept in a careless,

slovenly, inaccurate manner. The bureau is likewise influenced when an important detail is to be filled. It is only human for the commanding officer and the bureau to select for a particular detail the officer who can be trusted to do the work in a competent manner. The manner in which a medical officer keeps his medical records is a most important indicator as to his efficiency.

Medical records are valuable only when they are accurate and complete. It will repay us to read Lieutenant Commander Montgomery's article in the October, 1927, number of the Naval Medical Bulletin and to note what he says in regard to incomplete data in medical records containing entries for syphilis. In concluding his article the author states: " This study seems to show a real need for more complete and more accurate recording of data relating to the diagnosis, treatment, and progress of syphilis in the Navy. Many patients, fortunately, pass from one thoughtful, painstaking medical officer to another. Others do not." He then recommends a central clearing house where syphilitic data should be sent to be passed upon as to diagnosis, treatment, and cure. Would this be necessary if each medical officer were painstaking and accurate in recording all the facts and procedures he has noted or used in the diagnosis and treatment of the disease?

There is no doubt a good reason back of our carelessness, inaccuracy, and omissions. Many of us were never required to be careful and accurate. Our school days' performance was based on a barely passable record, with little regard to anything except what we were asked to do. When we came into the service or went into private practice there was no habit of investigation or clear thinking to carry us on. Our only thought was to do what we were asked to do and then only with enough labor to " get by " with it.

Who can gauge the intelligence back of an entry such as " usual symptoms," " characteristic of," " routine treatment," or " such as described by ———"?

The term " usual symptoms " may be found to describe any disease from acute tonsillitis to acute appendicitis. It may be true that every patient with tonsillitis may have inflamed, swollen, and painful tonsils, purulent exudate in the crypts, difficulty in swallowing, fever, rapid pulse, malaise, and prostration, but what of those cases in which the tonsilitis is accompanied by albumin and casts in the urine, an actute bronchitis, or an involved heart? These latter may apply years later for a pension based on a chronic nephritis, a chronic bronchitis, or a myocardial degeneration and, unless the medical officer has made a note of such conditions, the applicant may be refused a pension because there is no record that connects his disability with service origin. " Usual symptoms " in such a case has worse than no meaning; it deprives the man of information he has every right to obtain.

Aside from the demands of the Veterans' Bureau and the Pension Bureau for complete and accurate records there is the same demand from the standpoint of statistics. Outside of the military forces there is no other source where statistics can be gathered in such volume. Unless these statistics are accurate and complete they are of no or doubtful value. Anyone interested in knowing how many times tonsillitis is accompanied by albumin and casts in the urine will experience small comfort in reading "usual symptoms" in anywhere from 30 to 60 per cent of the cases and finding no record of a urine examination in 50 per cent of the remainder. As Lieutenant Commander Montgomery has pointed out, our medical records for syphilis are lacking in many respects. The same is true for gonorrhea and chancroid. In many of the gonorrhea cases the medical officer apparently does not have the time to enter "usual symptoms," he simply puts down "gonococcus infection of the uretha, admitted and discharged, to continue treatment." Such an entry is of no use to anyone except to be added to the list of diseases as one more case of gonorrhea, and a doubtful one at that. An entry of the character of the urethral discharge and the findings under the miscroscope would make the diagnosis certain and the record a valuable one.

It has been noted that the records for surgical diseases are more satisfactory, as a rule, than those for medical diseases, but even here there are many instances of incomplete records. A "McBurney incision" is only the first step in an appendicitis operation, yet many officers use it to describe the whole operation. The medical officer derives small satisfaction when he finds such an entry and is confronted with the necessity of an operation for adhesions or an acute abdominal condition at a later date. If the record had stated that the appendix was retrocecal, with its tip near the gall bladder, that its tip was bound down by adhesions in the pelvis, or that the appendix was free and in normal position, it would give the operator some idea as to the conditions found at the previous operation. Even a statement that the appendix had been removed would be of some assistance.

Some medical records read somewhat as follows: "Multiple injuries, extreme. Patient was injured and died from the injuries received in an automobile accident. He was dead when the ambulance arrived at the scene of the accident. Brought to the hospital and prepared for burial." Anyone interested in obtaining data relative to the fractures most frequently observed following automobile accidents would receive very little information from such a record.

Medical records need not be verbose. The more terse the words, the clearer the mental picture to be derived from reading the record. A simple enumeration of the fractures incurred in an automobile accident would be better than the record as given in the last para-

graph. It is frequently noted that voluminous medical records are often nothing but words which convey little information or meaning.

There has been noted very little initiative on the part of medical officers to express their opinion in regard to the time of appearance of a disability. Diseases or injuries that are manifestly due to causes that existed prior to enlistment are stated as having been contracted after entry into the service. The medical officer should express an opinion based upon his professional knowledge together with the facts of the case rather than upon the legal findings in some other case that may be thought to be similar. All the facts in the case and the medical officer's opinion in relation to the facts are necessary if a case is to be referred to the office of the Judge Advocate General for a determination of the misconduct or duty status.

There are three criteria by which medical records—also the medical officer—may be judged, and they may be summed up by the three words: Conciseness, accuracy, completeness.

## TYPHOID VACCINE IN THE ARMY

In circular letter No. 26, dated October 21, 1927, the Surgeon General of the Army, directed that on May 1, 1928, the Army would discontinue the use of "triple typhoid vaccine" and would substitute therefor a new vaccine, to be known as "typhoid-paratyphoid A."

Since the time of the entry of the United States into the World War, "triple typhoid vaccine", containing strains of *B. paratyphosus* A and *B. paratyphosus* B, as well as of *B. typhosus*, has been used in the Army.

When troops were mobilized on the Mexican border, before this country entered the World War, the presence of outbreaks of paratyphoid A made it seem wise to protect against *B. paratyphosus* A, in addition to giving the straight typhoid vaccine, which had been in use up to that time. The Army will now make and issue a vaccine containing strains of *B. typhosus* and *B. paratyphosus* A.

As is well known, the Navy has, since November, 1924, used only the straight typhoid vaccine, as reactions following the use of the triple vaccine were often severe and the duties of the Navy do not frequently expose its personnel to the danger of infection with *B. paratyphosus* A or B.

## ANNUAL MEETING OF ASSOCIATION OF MILITARY SURGEONS

The Association of Military Surgeons of the United States will hold its annual meeting at Baltimore, Md., October 4 to 6, 1928.

The proximity of Baltimore to many naval activities should insure the presence of many naval medical officers at this meeting.

The meetings of the association are always inspiring and well worth attending. This one will be no exception. It is probable that Baltimore, Washington, Annapolis, and Edgewood Arsenal will all have places on the program and provide interesting and instructive exhibits.

The president of the association is Col. Frederick H. Vinup, Medical Corps, Maryland National Guard. Those who attend may be sure of finding a warm welcome to his home city, Baltimore, and it is hoped that among these will be many from the Navy.

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### THE AMERICAN COLLEGE OF PHYSICIANS

The secretary general of the American College of Physicians has notified the Surgeon General of the Navy that hereafter all applications for fellowship in the college from officers of the Medical Corps of the Navy should be forwarded through the Surgeon General.

The Surgeon General will cooperate with the college by indorsing such applications as are received and by recommending for fellowship such medical officers as are deemed suitable for the organization.

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### ARMY AND NAVY GENERAL HOSPITAL, HOT SPRINGS NATIONAL PARK, ARK.

At the request of the commanding officer of the Army and Navy General Hospital, Hot Springs National Park, Ark., the attention of medical officers is called to the splendid facilities for the treatment of certain diseases offered by that institution.

The diseases which seem to be most greatly benefited by treatment at Hot Springs are those due to focal infections, such as arthritis and the various metabolic diseases. In order that patients suffering from these diseases may derive the greatest benefit from the treatment, they should be sent to Hot Springs before the disease has become definitely chronic.

The procedure to be followed in transferring a patient to Hot Springs may be found in the Manual of the Medical Department, United States Navy, 1927.

### BIBLIOGRAPHIC SERVICE ON MENTAL HYGIENE

The news department of the National Committee for Mental Hygiene has requested that the notice which follows be published:

With the flood of psychological literature, sound and unsound, pouring from the presses to-day it is becoming increasingly difficult to keep in touch with even the leading contributions through ordinary channels.

To help meet this situation, especially with reference to its mental-hygiene aspects, the library of the National Health Council is issuing an annotated

Weekly Bibliography on Mental Hygiene and Related Subjects, prepared by a librarian who specializes in this field and who has at her disposal unusual sources of information for her work.

Mental and nervous diseases, mental defect, endocrinology, normal and abnormal psychology, psychoanalysis, psychopathology of crime, delinquency and dependency, behavior disorders, child guidance, social psychiatry, intelligence testing, penology, educational and industrial psychology, vocational guidance, clinical psychiatry, social case work—the Weekly Bibliography covers the whole range of mental hygiene and allied subjects.

The bibliography is printed in two columns, alphabetically, with a descriptive note supplementing each item, and so arranged as to permit convenient clipping for card-index purposes.

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## ANNUAL GRADUATE FORTNIGHT OF THE NEW YORK ACADEMY OF MEDICINE

An unusual opportunity to study the degenerative diseases of old age will be given by the New York Academy of Medicine October 1 to 13 by means of a program of lectures, clinics, and courses in hospitals and teaching institutions.

This is to be the first "Annual Graduate Fortnight" of the academy, inaugurating a form of graduate medical education novel in this country. In October of each year a problem of medicine or surgery of outstanding importance and interest to practicing physicians will be selected. The topic for 1928 is described as "The problem of aging and diseases of old age."

Not only will the diseases and management of old age be discussed, but attention is to be directed toward the prevention of premature and postponing of normal aging. Diseases of the heart, and affections of blood pressure and kidneys will be studied under the guidance of men of national and international reputation.

By concentrating all the available knowledge and experience on a single problem each year it is believed the greatest benefit to general practitioners, and specialists as well, can be secured. The coming sessions will devote considerable time to pointing out the effect of wrong modes of living. Aging, as it relates to health insurance and to economic and industrial problems, is to be included in the curriculum.

No fees are to be charged for the fortnight. It is not expected that every physician will feel disposed to attend all of what will be a program of long duration each day. Special courses to be arranged in conjunction with the sessions by medical schools and teaching hospitals may, however, carry a nominal charge for those who attend them.

Sessions are scheduled for morning, afternoon, and evening, with suitable arrangements for physicians from out of the city to have supper served at the academy between the afternoon and evening sessions.

# BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

**The Editor,**
**United States Naval Medical Bulletin,**
**Bureau of Medicine and Surgery, Navy Department,**
**Washington, D. C.**
**(For review.)**

**NELSON LOOSE-LEAF LIVING SURGERY, prepared under the direction of an advisory board comprising the leading surgeons in the profession. Editor in chief, *Allen O. Whipple, M. D., Professor of Surgery, College of Physicians and Surgeons Columbia University; Director of Surgical Service, Presbyterian Hospital, New York City.* Associate editor, *Fordyce B. St. John, M. D., Professor of Surgery, College of Physcians and Surgeons, Columbia University, New York City.* In eight fully illustrated volumes, including index. Thomas Nelson & Sons, New York.**

We have for review the first four volumes of this monumental work, produced by a firm which has been one of the foremost publishers of encyclopedias for many years. The list of 75 contributors is practically an honor roll of the surgeons of to-day. So there is little need to call attention to the excellencies of the volumes.

The principal consideration to us is the suitability of this work for use in the Medical Department of the Navy. The reviewer believes that as a rule the systems running into many volumes are not used enough to justify their cost. The impulse to look up a doubtful point is usually so feeble that it fades away when one is confronted by a set of 8 or 10 large volumes within which the desired information is concealed. These sets of books remain in excellent condition for years because they are so seldom used while the shorter monographs quickly show signs of wear.

In the case of the loose-leaf systems, which are constantly refreshed by the addition of new matter and deletion of the obsolete, there seems to be a change for the better and they are more used. The reviewer believes it to be desirable that our naval hospitals be supplied with one or the other of the loose-leaf systems of surgery.

**PHYSICAL DIAGNOSIS, by *Charles Phillips Emerson, A. B., M. D., Professor of Medicine, Indiana University School of Medicine; author of Clinical Diagnosis.* J. B. Lippincott Co., Philadelphia, 1928.**

So much thought and interest has been given to the aid of instrumentation in diagnosis that the primary and fundamental method of diagnosis has been placed in the list "as taken for granted if not losing its place as a prominent factor in the medical profession."

The author, who was an assistant to Osler and is prominent as a clinical diagnostician, realizes the importance of the physical findings as the primary diagnostic aid. This book was produced by a scholar, teacher, and prominent diagnostician.

Most of the illustrations are new, especially selected, and arranged to bring out the author's ideas on the subject. The book is very well written, on good paper, and is easy to read.

The author is one of the internationally known diagnosticians and teachers in the practice of medicine at the present time. His idea of medical practice and training students for the profession is to make the young doctor useful and beneficial to the public. This book has been prepared and published to show the student and young doctor the importance and actual worth of physical diagnosis. It is an excellent book, dealing with a most interesting subject.

PATHOLOGICAL PHYSIOLOGY OF INTERNAL DISEASES, by *Albion Walter Hewlett, M. D., B. S., formerly Professor of Medicine, Stanford Medical School; Professor of Internal Medicine and Director of Clinical Laboratory, University of Michigan.* Revised in memoriam by his colleagues in the Stanford Medical School, under the editorial supervision of *George DeForest Barnett.* D. Appleton & Co., New York, 1928. Price $8.50

This is the third edition of Hewlett's book, the first of which appeared in 1916. This edition contains 787 pages, including the index, with 164 illustrations, and is printed on thinner paper and is a much neater and smaller volume than the second edition, which contains 765 pages, including the index.

The subject matter is divided into 13 chapters: "The circulation, digestion, and absorption"; "The metabolism"; "The disturbances in the carbohydrate metabolism"; "The Purin metabolism-gout"; "Diseases of the liver and pancreas"; "Disturbaces of respiration"; "Disturbances of kidney function"; "Disturbances of heat regulation—fever, infection, and immunity"; "The blood"; "The endocrine glands"; and "The nervous system." There are numerous illustrations and a comprehensive index. The authors of the present revision have carried out Hewlett's original idea to make the presentation brief and more readable by omitting historical and controversial matter. The volume abounds with references at the end of each chapter for those who desire to read the subject matter more in detail. While this edition, on the whole, has been brought up to date, one looks in vain for information on sickle cell anemia, and the effect of the arsenicals on the liver; but, despite the few omissions, it is a clear and readable volume covering a wide range of subjects in general terms, and furnishes the clinician the principles underlying pathological physiology. This book is essentially a commentary on pathological physiology and obviously was not intended for the undergraduate medical student. Regardless of this fact it is a

book that can be taken to the bedside, and the interne or anyone having a knowledge of physiology could read it with profit. It was a pleasure to read this book, as it contains the essential points necessary for a review of the subject and it can be highly recommended to the clinician. This book would be a valuable asset to any hospital library.

Bedside Diagnosis, by *American authors.* Edited by *George Blumer, M. D., David P. Smith, Clinical Professor of Medicine, Yale University School of Medicine; Attending Physician to the New Haven Hospital.* In three volumes and a general index. W. B. Saunders Co., Philadelphia, 1928. Price $30 per set.

During recent years the swing toward making diagnoses by laboratory procedures has been very pronounced. It is high time that we should go back to making diagnoses by "bedside" study, using our natural senses and simple diagnostic aids to enable us to reach our conclusions, and relying upon the laboratory only for confirmatory evidence, or where our senses, unaided, are insufficient for the purpose.. With this in view, Doctor Blumer and the eminent clinicians associated with him, have written this new "system of medicine."

The three volumes of this set contain all the latest information concerning symptoms of diseases, and a study of them will enable the practicing physician to reach the correct diagnosis in most cases, even though he does not have access to or avail himself of the use of a modern, technical, diagnostic laboratory.

The authors have not made the mistake of belittling the importance of laboratory aids to diagnosis. This is admitted, and the procedures which should be used in each disease are briefly mentioned. Some of these may be employed at the bedside and may rightly be included in "bedside diagnosis." All through the work, however, emphasis is placed upon signs and symptoms.

All diseases are discussed in these three volumes and discussed thoroughly. The names of the contributors—of whom there are 64—are a guarantee that the information given is authoritative.

There was a real need for such a work. These volumes meet it splendidly.

Pharmacotherapeutics, Materia Medica and Drug Action, by *Solomon Solis-Cohen, M. D., and Thomas Stateshury Githens, M. D.* D. Appleton & Co., New York, 1928. Price, $15.

This new and exhaustive volume fully measures up to the well-known qualifications of the authors. It is a monumental work and is most thorough in its presentation of the available facts in relation to the use of drugs.

The first part of the book is given over to a philosophic presentation of the factors relating to the use of medicinal agents. The

authors have stressed the Hippocratic maxim: "Do good, or do no harm," and the other equally important fact of "The right drug, given at the right time, in the right manner and for the right purpose, to the right person."

The latter part of the book is devoted to the materia medica and therapeutics of the various medicinal agents and is divided into the three orders: I. Antipathogens; II. Tissue alterants, and III. Function modifiers. Under these three orders every medicinal preparation accepted by the latest editions of the U. S. Pharmacopœia, the National Formulary, the U. S. Dispensatory, the British Pharmacopœia, and New and Non-Official Remedies are thoroughly discussed with minute instructions as to their administration or application. Even such a minor matter as the application of a skin irritant, such as a blister, is fully described.

Owing to the use of India paper and the method of binding, the book is not unwieldy, despite its 2,000 pages. The print and the index are all that could be desired.

This book fills a long-felt need for a reference book on drugs that are not included in the official publications and one that—as this book does—gives all the facts both for and against the use of the particular drug.

Diseases of the Intestines, including the Liver, Gall-Bladder, Pancreas, and Lower Alimentary Tract, by *Anthony Bassler, M. D., F. A. C. P., Consulting Gastroenterologist, St. Vincent's, Peoples, and Jewish Memorial Hospitals, New York City; formerly Professor and Director of the Department of Gastroenterology, New York Polyclinic Medical School and Hospital; Professor of Gastroenterology of the late Fordham University Medical School; Fellow American College of Physicians and the New York Academy of Medicine; ex-Chairman of the Section of Gastroenterology and Proctology, A. M. A., etc., etc.* F. A. Davis Co., Philadelphia, 1928. Price, $9.

An excellent guide and reference book, written by a man of vast experience who has a careful and studious trend of mind.

It is recommended as a book that will be valuable to all internists. Surgeons, also, will find the discussions and conclusions to be helpful and important.

Brain and Mind, the Nervous System of Man, by *R. J. A. Berry, M. D., F. R. C. S., F. R. S., Edin., Dean of the Faculty of Medicine and Professor of Anatomy, including Histology, in the University of Melbourne.* First edition. The Macmillan Co., New York, 1928. Price, $8.

The mechanism of the human mind has been long a cause for study and conjecture. The author of this book approaches it from the viewpoint of an anatomist and a histologist. He somewhat dogmatically states that "study thus forces upon us the inevitable and only logical conclusion that the neuron, particularly the short interpolated or internuncial neuron, is the physical instrument of mind, but that consciousness, memory, speech, thought, and reason

can only manifest themselves when there are a sufficiency of neurons for the purpose. If * * * these neurons should be deficient from developmental or other cause, there are inevitably produced aberrations of intelligence and mind with corresponding alterations in the reactions to the environment, that is, the behavior of the individual becomes modified in accordance with the cortical development of the neurons."

Whether or not one concurs with the author in his deductions based upon physical structure it is a fact that he has written an interesting and most lucid description, anatomically and physiologically, of the nervous system of man. Starting with a histological description of the structural elements of a simple neuronic arc he traces the development, through neurosynapses and internuncial neurons, of the most complicated psycho-associational neurons. In a systematic and consecutive manner there follows a description of the structure and function of the entire nervous system.

The chapter on the autonomic nervous system is a clear exposition of the structure and function of that part of the nervous system of man which is not always easily comprehended. There is a chapter on " Speech, its acquisition and loss " and one on cerebral localization in which the subject is viewed somewhat differently from the usually accepted manner. The chapter on " Head size as a diagnostic indication of cerebral insufficiency " and the one on " The clinical diagnosis of amentia " are perhaps open to controversy.

On the whole this book may be commended as an excellent and interesting description of the histological and anatomical structure of the human nervous system and of its function.

X Rays and Radium in the Treatment of Diseases of the Skin, by *George M. MacKee, M. D., professor of and director of the Department of Dermatology and Syphilology, New York Post Graduate Medical School and Hospital; Member American Dermatological Society; Member American Roentgen Society; etc.* Second Edition. Lea and Febiger, Philadelphia, 1927. Price $10.

The second edition of this well-known book has given the author an opportunity to revise his original work and to bring the subject matter up to date. In an appendix the author discusses the long wave-length radiation advocated by Bucky and others. The chapters on radium and methods of application are most valuable and comprehensive.

The reader is most impressed by those chapters of the book which, to a great extent, are based on the author's long experience in the use of roentgen radiation in the treatment of diseases of the skin. The conservative conclusions drawn from the author's experience should prove a valuable guide to medical officers in the application of superficial roentgenotherapy. Even with the conservatism of the

author the field of usefulness of superficial roentgenotherapy is surprisingly broad. In several types of skin disease this modality is the author's first choice of therapeutic agents.

The author takes sharp issue with those who advocate the use of ultra-violet radiation to counteract the biological effect of roentgen radiation. The experiments cited are most convincing. The author holds that once a given quantity of radiation has been administered to the human organism the biological effect is beyond recall or alteration in any manner.

One chapter reviews at considerable length the present-day opinion in regard to the use of roentgen radiation in the treatment of facial hypertrichosis. The author leaves no doubt as to the very real danger of permanent damage to the skin following the use of radiation for the removal of superfluous hair from the face, and quotes from the reports of many therapists to emphasize this point.

The thoroughness with which this book has been prepared is indicated by the very complete bibliograph at the end of each chapter. The book is commended to dermatologists and roentgenologists, and especially to medical officers interested in either of these specialized arts.

DIABETES: ITS TREATMENT BY INSULIN AND DIET, by *Orlando H. Petty, A. M., M. D., F. A. C. P., Professor of Diseases of Metabolism, Graduate School of Medicine, University of Pennsylvania, etc.* Fourth edition, revised and enlarged. F. A. Davis Co., Philadelphia, 1928.

Doctor Petty's little book for the use of the patient whose health is dependent upon insulin injections and a diabetic diet has reached its fourth edition in four years. This is evidence of its worth.

Any diabetic will have a better understanding of his disease after reading this book and will be able to arrange his diet without complicated mathematical computations from the tables which are given.

Physicians will confer a favor upon their patients by seeing that they have and read this little volume.

THE ART OF ANESTHESIA, by *Paluel J. Flagg, M. D., Visiting Bronchoscopic Anesthetist, Manhattan Eye and Ear; Anesthetist to St. Vincent's Hospital, Fifth Avenue, and Flower Hospitals, New York City, etc. Formerly Lecturer to Rockefeller Institute, War Demonstration Hospital, and the College of Physicians and Surgeons, New York City.* Fourth edition, revised. J. B. Lippincott Co., Philadelphia, 1928. Price, $5.

A scholarly dissertation in which the principal attention is paid to the technic of administration of anesthetics. Theory and basic principles, which fill so large a part of most books on the subject, are mercifully absent.

Each anesthetic agent is thoroughly discussed and at the end of the section is a summary of the advantages, disadvantages, and indications for use of the particular agent.

Local, block, and spinal anesthesia receive brief notice.

A valuable book for the specialist in anesthesia.

Recent Advances in Tropical Medicine, by *Sir Leonard Rogers, C. I. E., M. D., B. S. (Lond.), F. R. C. P., F. R. C. S., F. R. S., Indian Medical Service, Ret., Physician and Lecturer, London School of Tropical Medicine, Late Professor of Pathology, Medical College, Calcutta.* P. Blakiston's Son & Co., Philadelphia, 1928. Price, $3.50.

Every physician who is called upon to treat tropical diseases needs this book. A study of it is equivalent to several years' study of all the journals dealing with tropical diseases. That it is written by Rogers is sufficient guaranty that it is authoritative and that it contains the latest information.

All the more common diseases of the Tropics and sub-Tropics are discussed, special attention being given to treatment, which is presented in such a way that anyone can understand it.

Of particular value are the chapters on cholera and leprosy, two diseases with which the author's name is always associated.

Rogers's hypertonic saline and alkaline treatment for cholera is discussed in detail.

The references given at the ends of the chapters show the sources, other than the author's vast personal experience, from which the information given has been obtained.

Crawford W. Long and the Discovery of Ether Anesthesia, by *Frances Long Taylor.* Paul B. Hoeber (Inc.), New York, 1928. Price, $4.

That Crawford W. Long, of the little town of Jefferson, in the State of Georgia, was the first to use ether to abolish pain in a surgical operation, is acknowledged by all at this time. Papers have been written and affidavits submitted to prove the fact. The ether controversy, which raged with such bitterness and with such disastrous results to most of those who claimed priority in the use of the drug, has been settled and Long has been awarded the honor which is rightfully his.

The author of this book is a daughter of Doctor Long. She gives intimate glimpses into the life of her distinguished father such as could be given by no one else. Aside from again presenting the well-known proof that on March 30, 1842, Long first used ether as a surgical anesthetic, Mrs. Taylor has written a book which is peculiarly fascinating and which may be read with profit and pleasure by anyone. She has shown that life in an isolated community may be productive of most eventful happenings. Such was the life of Long.

Physical Diagnosis, by *W. D. Rose, M. D., Associate Professor of Medicine in the University of Arkansas, Little Rock, Ark.* Fifth edition. The C. V. Mosby Co., St. Louis, 1927. Price $10.

To reach a fifth edition a book must have proved its worth. Such is the case with this "Physical Diagnosis," which, although it con-

tains nothing new, and in some instances seems to be too brief, is, on the whole, a good book for the general practitioner.

STRABISMUS, by *Oscar Wilkinson, A. M., M. D., D. Sc., Surgeon in Chief of the Washington Eye and Ear Hospital, Washington, D. C.* The C. V. Mosby Co., St. Louis, 1928. Price $10.

The problem of strabismus has been and will continue to be one of the most difficult the ophthalmologist is called upon to solve.

The author of this book has presented in rather concentrated form a great mass of helpful information on all phases of the subject. The question of the proper age for operation on the strabismic child has brought forth an unlimited number of opinions. Wilkinson urges early operation and presents many convincing results upon which to base his argument.

This book is rcommended for the great amount of useful information which it contains.

HYPOTENSION, by *Alfred Friedlander, Professor of Medicine, College of Medicine, University of Cincinnati.* Medical Monographs, Volume XIII. The Williams & Wilkins Co., Baltimore, Md., 1927.

This is a review and an analysis of the literature on the subject.

The subject is well covered. The clinical findings of low blood pressure in the acute and chronic diseases are discussed. Hypotension in relation to the endocrine disorders, known to exist by clinical observation and experimental study, are not adequately explained, due to the lack of definite knowledge of what takes place.

A clearer conception of hypotension is obtained by reading the book. The author brings out some very interesting facts concerning the clinical side of temporary hypotension and malfunctions of the factors which normally maintain blood pressure.

It is well written and is an exceedingly interesting book.

THE PHYSIOLOGY OF EXERCISE, by *James Huff McCurdy, A. M., M. D., M. P. E., Director of Physical Education Course in the International Young Men's Christian Association College, Springfield, Massachusetts; Editor of the American Physical Educational Review.* Second edition, thoroughly revised. Lea and Febiger, Philadelphia, 1928. Price, $3.

This text was developed from a lecture course arranged to meet the needs in the field of physical education.

The chapter headings are "Physiology of exercise an integral part of physical education," "General types of exercise," "Circulation—Heart rate," "Circulation—Blood pressure," "Respiration," "The blood in relation to exercise," "Neuromuscular mechanism," "Gymnastics—Athletics," "Aquatics," "Physical efficiency tests," "Physiology of training."

A Handbook of Ophthalmology, by *Humphrey Neame, F. R. C. S., Ophthalmic Surgeon, University College Hospital; Assistant Surgeon, Royal London (Moorfields) Ophthalmic Hospital; Consulting Ophthalmic Surgeon, Dr. Barnardo's Homes,* and *F. A. Williamson-Noble, F. R. C. S., Assistant Ophthalmic Surgeon, St. Mary's Hospital; Assistant Ophthalmic Surgeon, National Hospital, Queen Square; Assistant Surgeon, Central London Ophthalmic Hospital.* William Wood & Co., New York. 1927. Price, $4.

This manual is intended for the use of the undergraduate student and the general practitioner. No reference is made to the rarities of ophthalmology and the uncommon affections receive brief notice. The common ocular conditions are described in great detail, and the technic of examination of the eye is carefully explained. The colored illustrations make it possible to recognize at a glance the everyday lesions.

For the medical officer on board ship who must care for diseases of the eye without a specialist to aid him, this book will be found invaluable.

The Peaks of Medical History, by *Charles L. Dana, A. M., M. D., LL. D., Professor of Nervous Diseases, Cornell University Medical College; ex-President of the New York Academy of Medicine, etc.* Second edition. Paul B. Hoeber (Inc.), New York, 1928. Price, $3.

No member of the medical profession can afford to be ignorant of the history of medicine. A knowledge of this history will surely increase one's pride in one's profession and will stimulate one's ambition. Complete acquaintance requires extensive reading, but a study of Doctor Dana's little book takes but little time and will give to anyone a fair knowledge of the subject.

The peaks of medical history, according to Doctor Dana, are the Hippocratic period, the Alexandrian school, Galen and the post-Galenic period, the renaissance of medicine, the period of Harvey, physiology and research, and the period of Jenner and modern medicine.

For those who desire and find time to delve more deeply into the subject, bibliographic notes are added.

The book is delightfully written, and anyone who reads it will consider his time well spent.

The Practice of Periodontia, by *Sidney Sorrin, D. D. S., Chief of Periodontia Clinic, New York University College of Dentistry, Periodontia Department, N. Y. U. College of Dentistry* and *Samuel Charles Miller, D. D. S., Instructor, Periodontia Clinic, N. Y. U. College of Dentistry, Periodontia Department, N. Y. U. College of Dentistry.* The Macmillan Co., New York, 1928. Price $3.50.

A 150-page volume on the etiology, diagnosis, and treatment of periodontia with a specific explanation of the histology, physiology, and pathology of the tissues involved, well illustrated with photo-

micrographs and roentgenograms of various periodontal lesions and conditions.

A firm adherence to the reattachment theory is expressed, and timely and valuable chapters are devoted to "Vincent's infection," and to "Diet and its relation to periodontal disease."

This is a clear and concise treatise, not beclouded with unnecessary matter, and is recommended to the profession as a book which will be found both interesting and useful.

DISEASES OF THE SOFT STRUCTURES OF THE TEETH AND THEIR TREATMENT, by *Hermann Prinz, A. M., D. D. S., M. D., D. Sc., Professor of Materia Medica and Therapeutics, The Thomas W. Evans Museum and Dental Institute, School of Dentistry, University of Pennsylvania, Philadelphia.* Lea and Febiger, Philadelphia, 1928.

This volume shows the same painstaking care which is characteristic of all the works of Professor Prinz. It is a scientific version and should prove an invaluable addition to the library of every dental practitioner.

In this, his latest work, Doctor Prinz reviews oral disorders from microscopical and macroscopical viewpoints and presents a thorough description of the clinical and differential diagnosis of diseases of the soft tissues. The numerous illustrations contained tend to increase the clarity of the theoretical and practical teachings of the author. A complete and interesting chapter is devoted to "Local anesthesia as applied to the treatment of diseases of the soft structures of the teeth."

This treatise will serve excellently for reference purposes in the diagnosis and treatment of oral disease. It is well printed on good paper and the contents are conveniently divided, under appropriate headings, so that reference is greatly facilitated.

PRACTICAL DIETETICS FOR ADULTS AND CHILDREN IN HEALTH AND DISEASE, by *Sanford Blum, A. B., M. S., M. D., Head of Department of Pediatrics and Director of the Research Laboratories, San Francisco Polyclinic and Post-Graduate School.* Third revised and enlarged edition. F. A. Davis Co., Philadelphia, 1928. Price, $4.

This is the third edition to appear in the past five years. It is a book based on the author's 20 years' experience in dietetics. The three important factors governing successful dietaries, namely, correct diet, one of such a nature that the patient can follow with a variety of choice, and one the patient can afford, are fully discussed. The point that diets must be individualized for each patient and adapted to the patient as well as the disease it brought out.

The chapter on diabetes has been rewritten, covering the general principles of diabetic diet with insulin treatment, and composition and caloric values of foodstuffs are incorporated in this edition. The book contains the most recent knowledge of nutrition that has been

found to be of practical value, such as the advances in dietetics, with explanatory notes, in treating pernicious anæma, high blood pressure, etc.

The book is well bound, written on fair paper, and easy to read.

HANDBOOK ON DIET, by *Eugene E. Marcovici, M. D., Instructor, Post Graduate Hospital; Assistant Attending Physician, Roosevelt Hospital, New York, etc.* F. A. Davis Co., Philadelphia, 1928. Price, $3.50.

The author has written a book which is intermediate between the ultrascientific and the lay press. It presents the dietectic principles on which the feeding of patients is based and then discusses the use and types of food and impurities found. Several chapters are devoted to types of diet, both in health and in the treatment of various diseases. Recipes for sick-room use and useful tables are included. In the last two chapters are lists of mineral waters with their predominating salt and the better-known bath resorts at home and abroad. The book is well indexed.

THE PRINCIPLES OF SANITATION, by *C. H. Kibbey, Director of Sanitation, Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.; Member, American Public Health Association; Honorary Member Alabama Conference of Health Officers, etc.* F. A. Davis Co., Philadelphia, 1927.

During a period of several years the author has been delivering lectures and giving demonstrations to sanitary inspectors under his charge. These have now been collected and published in book form. As the inspectors to whom this instruction was given were not men trained in medicine, the book is elementary in character. Yet it contains much valuable advice and will be of great service to those for whose use it is intended.

ALUMINUM COMPOUNDS IN FOOD, including a Digest of the Report of the Referee Board of Scientific Experts on the Influence of Aluminum Compounds on the Nutrition and Health of Man, by *Ernest Ellsworth Smith, Ph. D., M. D., Fellow and Former President, New York Academy of Sciences; Fellow of the New York Academy of Medicine, etc., etc.* Paul B. Hoeber (Inc.), New York, 1928. Price, $7.

Owing to the widespread use of aluminum cooking utensils, the use of aluminum compounds in the preservation of certain foodstuffs, and in baking powder, this book, in which the author has collected records of research and investigations of the subject, should be of great value to those interested in the composition and value of food, particularly its relation to health.

THE MEDICAL DEPARTMENT OF THE ARMY, by *James A. Tobey, Major, Sanitary Corps (Reserve), United States Army.* The Johns Hopkins Press, Baltimore, Md., 1927. Price, $1.50.

This little book is No. 45 of Service Monographs of the United States Government, a series containing the facts concerning the

various branches of the Government and presenting them in such form as to make them readily available.

The history, activities, and organization of the Medical Department of the Army are given in this volume. In addition, an abstract of the laws relating to the Medical Department is appended.

To anyone interested, or who may have occasion to learn of the Medical Department of the Army, this book is highly recommended.

GYNECOLOGY FOR NURSES, by *Harry Sturgeon Crossen, M. D., F. A. C. S., Professor of Clinical Gynecology, Washington University Medical School, and Gynecologist in chief to the Barnes Hospital and the Washington University dispensary, etc.* The C. V. Mosby Co., St. Louis, 1927. Price, $2.75.

This interesting book covers two valuable subjects—" Nursing care of gynecological patients" and "Operative technique." There are 365 splendid illustrations, the type is clear, and the book is well indexed.

Nursing care of gynecological patients has been handled most carefully and thoroughly, not too technically. Chapter 1 contains a discussion of the elementary points in anatomy, physiology, and gynecological conditions, thus enabling the nurse intelligently to aid the surgeon and patient. In chapter 3, articles necessary for special examinations are shown. Details of technique in nonoperative measures are reviewed in chapter 4. Important operative measures are also discussed step by step and are well illustrated.

The duties of a nurse as office assistant and in a dispensary are enumerated and standardized operating room procedure is described in detail.

As a reference book for instructors of nurses and for the use of student nurses themselves, this work will be found of value.

HYGIENE AND SANITATION FOR NURSES, by *George M. Price, Author of "A Hand-Book on Sanitation," etc., Director of the Union Health Center, New York City, etc.* Fifth edition. Lea and Febiger, Philadelphia, 1927.

This is one of the Nurses Textbook Series published by Lea & Febiger, and a valuable one. The author has brought together in small space the facts of hygiene and sanitation which a nurse should know, and has presented them in such a way as to render them easily learned.

All nurses should know all that is contained in this book. That this is a good book from which to learn it is attested by the fact that it has reached its fifth edition.

SAFEGUARDED THYROIDECTOMY AND THYROID SURGERY, A Manual Designed as a Practical Guide for the General Surgeon, by *Charles Conrad Miller, M. D.* F. A. Davis Co., Philadelphia, 1928. Price, $3.75.

A careful examination of this volume leads one to conclude that the only reason for its existence is the author's desire to write another book.

# THE DIVISION OF PREVENTIVE MEDICINE

Commander M. A. Stuart, Medical Corps, United States Navy, in charge

## Notes on Preventive Medicine for Medical Officers, United States Navy

### AN OUTBREAK OF INFECTIOUS DIARRHEA ON BOARD THE U. S. S. "MELVILLE" ATTRIBUTED TO CONTAMINATION FROM GATUN LAKE, CANAL ZONE

By Dallas G. Sutton, Commander Medical Corps, United States Navy

At the time the U. S. S. *Melville* was in transit through the Panama Canal from Balboa, Canal Zone, to Colon, Panama, in March, 1927, about 6,000 gallons of water from Gatun Lake were taken on board for use in the boilers and stored in the ship's tanks after distillation. The cloudy appearance, disagreeable aromatic "woody" odor, and unpleasant taste of this water, in contrast to that distilled from salt water while the ship was at sea and which was of good quality, attracted attention, so that samples of the water were immediately collected and cultures made. These cultures showed large numbers of gas forming microorganisms and indicated a heavy pollution of the water with the *Bacillus coli*. At the same time a number of the men comprising the crew developed symptoms of mild enteritis and were placed under treatment.

Following the isolation of *B. coli* from the fresh water supply of the ship and the appearance of cases of acute enteritis among the crew, the water was immediately pumped overboard and all tanks cleaned. They were then filled with freshly distilled water and disinfected by the addition of a solution of chlorinated lime. After this procedure no other cases of enteritis developed at this time. No water was taken on board from Gatun Lake during the return trip so that the water in tank No. A2, to which a later outbreak of acute enteritis was attributed, must have been overlooked when the other tanks were emptied, cleaned, and disinfected.

On or about June 30, 1927, or about three months after this experience with Gatun Lake water, the junior dentist on duty on board the U. S. S. *Melville*, which was then at San Diego, Calif., became ill with symptoms of a severe gastroenteritis. On subsequent days a number of the crew reported for treatment presenting similar symp-

toms with frequent small watery stools accompanied by abdominal pain of a moderately severe type.

These patients were taken sick at the rate of one or two a day over a period of about a week, so it soon became reasonable to suspect a common source of infection. With this in mind, a careful investigation was made in regard to all of the factors relating to food and water. It was noted that the distribution was general, as no two patients were from the same mess, that there was no great increase in the number of patients with gastrointestinal symptoms after any particular meal, and that the symptoms were not suggestive of food poisoning. Eliminating food poisoning as a causative agent, water was the next factor considered, so a sample taken from the crew's scuttle-butt was sent to the United States Naval Hospital, San Diego, Calif., for examination. A verbal report was received by the writer to the effect that the water gave no indication of bacteriological contamination.

It was learned afterwards that the water from which this sample was taken had probably not been obtained from the tank which later proved to be the source of the infection. The scuttle butt on that day had been supplied from another tank.

In view of this information the investigation was continued and it was learned that a mild intestinal type of influenza had been prevalent among the civilian population of San Diego during the preceding 10 days. It was considered then that influenza was a possible cause of the epidemic, and when no additional cases developed prior to the departure of the ship on July 11, 1927, it was thought that the outbreak had been controlled.

This conclusion proved to be erroneous, however, as on the two days following the departure of the U. S. S. *Melville* from San Diego, Calif., namely, July 12 and 13—a number of patients were admitted to the sick list and before the situation had been brought under control a total of 25 persons had been treated.

All fresh water was cut off from the scuttle butt and all other parts of the ship as soon as it appeared that the disease had reached epidemic proportions, and strict supervision of all food preparation was instituted. All fresh fruits and garden products were excluded from the diet for the reason that there was a possibility of chemical poisoning through the medium of arsenic. The Japanese farmers of California at times spray their fruits, and possibly other produce, with preparations of this drug. Boiled water only was issued to all on board, and in order to insure definite sanitary control frequent careful inspections of all messes, galleys, pantries, refrigerators, and other spaces used in the storage, preparation, and issue of food were made by the medical officer. All dishes throughout the ship were required to be boiled after meals, and all mess cooks were given a

physical examination to discover new cases and to remove all possible carriers from contact with food.

Cultures were made from lettuce, tomatoes, and fruits, but all of these articles were found to be free of pathogenic bacteria. These products were also examined for amebæ but none were found. Cultures were made from samples of water obtained from the scuttle butt and from each individual fresh-water tank on board ship. Water from the scuttle butt was found to be heavily contaminated with *B. coli* and water from tank No. A2 gave a growth of a gram negative bacillus having many of the general cultural characteristics of *Bacillus dysenteriae* (Flexner-Strong type), except that it was motile. A plate culture of this microorganism was sent to the U. S. S. *Relief* when the ship arrived at Seattle, Wash., and the bacteriologist of that vessel confirmed our diagnosis and findings. The bacteriologist of the State of Washington, at Seattle, expressed the opinion that the microorganism belonged to an intermediary group under the genus *Eberthella* and that it probably was the *Bacillus alcaligines fecalis*. It was later identified as such on board the U. S. S. *Relief* after special sugars had been obtained.

Clinically, all of the cases were very interesting. As in all similar epidemics, while the intensity of the disease varied considerably, it was noted that the onset was rapid in every case and accompanied by abdominal pain centered in the umbilical region. At the beginning of the attack each patient had frequent, small, watery bowel movements changing about the fifth day of the illness to a characteristic dysenteric stool containing both blood and mucus. In addition, each patient showed a varying degree of toxic symptoms and exhibited a heavily coated tongue, herpes, and a slight leukocytosis. A febrile reaction was present in many of the cases. In these the fever varied from 101° to 103° for about three days and then the temperature returned to and remained normal even though the intestinal condition was still acute. A very interesting condition noted was an increase of the transitional cells in the differential white blood-cell count. These cells varied from 8 to 25 per cent of the total number of white blood cells in over one-half of the cases. A differential count was not made in the remaining cases, due to the lack of time and of trained personnel. All of the patients responded to the simple form of treatment given and all recovered without complications within 10 days after the last case was admitted.

Early in the epidemic our greatest problem, of course, was to establish a diagnosis. The clinical symptoms presented by the patients were characteristic of some type of dysentery, but the negative report on the water just prior to leaving San Diego led us to consider other factors. Influenza of the intestinal type was at first

thought to be responsible for the outbreak, as it was prevalent in San Diego, but the patients did not exhibit the usual catarrhal symptoms. The intestinal pain was more severe than in influenza and the character of the stools was more suggestive of dysentery. In addition, all of the patients had a leukocytosis rather than the leukopenia expected in influenza.

During the time we were trying to establish the diagnosis, in addition to a white blood cell count, which was made in several instances, the stools were examined for amebæ and cultured. On the morning that the results from the cultures of the water were available we also had the results of the cultures from these stools. The bacilli isolated from the stools showed exactly the same cultural characteristics as those obtained from the fresh water supply of the ship and this circumstance indicated the source of the infection.

The scuttle butt, which had been cut off, was now thoroughly cleaned and disinfected with live steam under pressure. All the water used for drinking or culinary purposes was boiled prior to issue and fruits and vegetables were again allowed to be used. Following these precautions no further cases developed. All fresh water tanks were cleaned, refilled with freshly distilled water, and treated with a solution of chlorinated lime. This procedure was repeated while the ship was at the navy yard, Mare Island, Calif., in August, 1927; in fact, the water was chlorinated on two different occasions while at the navy yard and subsequently all tanks were found to contain water that was free from all pathogenic microorganisms.

Realizing that one emergency fresh-water tank, No. A2, had been responsible for the epidemic, an investigation was started to determine if possible how contamination of the contained water had taken place. This tank had been filled with water from Gatun Lake which had been treated by passing through the evaporators during the passage of the ship through the Panama Canal on March 4, 1927. Ordinarily water from tank No. A2 is not used except in case of an emergency, but on the day that cultures were made and a gram negative motile bacillus isolated, water was being pumped from it. The data available indicate that water from this tank was supplied to the scuttle butt for the first time on or about June 30, 1927, or the day the first patient, the junior dentist, was taken sick. Many of the patients stated that they first noticed symptoms of discomfort in the abdomen on or about July 4, 1927, or about four days later, but delayed from three to five days in reporting for treatment as they considered, in most instances, that their illness was due to dietary indiscretions ashore in San Diego. The greatest number of acutely ill patients reported on or about July 12, or a little more than a week after the water from tank No. A2 had been issued for drinking purposes.

It is, therefore, believed either that water from Gatun Lake found its way into this tank through a valve that had been left open, or that infected water was delivered by the ship's evaporators to the tanks while in Gatun Lake and that this tank was overlooked during the cleaning and disinfection of supposedly all the tanks at that time.

The writer's experience in this epidemic has led him to appreciate the great value of a trained bacteriologist as a part of any service organization either ashore or afloat. Had it not been for the hospital corps man aboard who had special training in bacteriology our problem would have been much more difficult to solve. We were prepared with necessary culture media to go ahead along certain plainly indicated lines and within 48 hours after the epidemic really started we had the answer to the abnormal situation. Had a trained man not been aboard, one of our two medical officers would have been forced to discontinue other essential work in relation to patients and sanitation to do the culture work. As it was, a medical officer merely supervised the work, and when the opportunity presented he assisted in the examination of stools.

In order to determine the quality of Gatun Lake water, bacteriological examinations were made with samples taken from several parts of the lake while the U. S. S. *Melville* was returning to the west coast through the Panama Canal in June, 1927. Samples taken from over the side and from the evaporators while the ship was at anchor in San Diego Bay, Calif., during November, 1927, and January, 1928, were also examined.

The results are indicated in the following table:

[A=Acid production: G=Gas formation]

| Date | Source | Lactose | Saccharose | Maltose | Mannite | Glucose | Russell's media, slant | Motility | Staining |
|---|---|---|---|---|---|---|---|---|---|
| Mar. 4, 1927 | Gatun Lake, scuttle butt and tanks. | AG | 0 | AG | AG | AG | AG | X | Gram. negative bacilli. |
| June 12, 1927 | Gatun Lake, Atlantic side. | AG | AG | AG | AG | AG | A | X | Do. |
| Do. | Gatun Lake, central section. | AG | AG | AG | AG | AG | A | X | Do. |
| Do. | do. | AG | AG | AG | AG | AG | A | X | Do. |
| Do. | do. | AG | AG | AG | AG | AG | A | X | Do. |
| Do. | Gatun Lake, Pacific side. | AG | AG | AG | AG | AG | A | X | Do. |
| June 30, 1927 | San Diego, Calif., scuttle butt. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Negative. |
| July 13, 1927 | At sea scuttle butt | 0 | 0 | 0 | 0 | 0 | Alk. | X | Gram, negative bacilli. |
| Do. | At sea, tank No. A2 | 0 | 0 | 0 | 0 | 0 | Alk. | X | Do. |
| Nov. 14, 1927 | San Diego, Calif., overside. | AG | AG | AG | AG | AG | A | X | Do. |
| Do. | San Diego, Calif., evaporators. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Negative. |
| Jan. 12, 1928 | San Diego, Calif., overside. | AG | AG | AG | AG | AG | A | X | Gram, negative bacilli. |
| Do. | San Diego, Calif., evaporators. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Negative. |

While at San Diego, Calif., cultures made from water taken from the ship's evaporators were negative, while those made from samples taken from over the side have shown heavy bacterial growth. This growth included a spore-bearing bacillus and other unidentified micro-organisms in addition to *B. coli.*

From the limited experience on board this ship, it would seem that while water of good quality, as indicated by the bacterial content, is delivered from the distilling plant when salt water is used for evaporator feed, there is apparently the hazard that bacteria may be carried over when polluted fresh water is so employed.

Whether this is because of the temptation to pass such water through the distilling plant at a rate above the normal capacity is not definitely known; however, such a possibility probably did occur. Further investigation, in our opinion, should be carried out on this question by medical officers as opportunity is presented. When a ship is operating under conditions where polluted fresh water is used as evaporator feed, it would not be a difficult matter to make cultures for determining the presence of members of the *B. coli* group of bacilli with samples of water from the evaporators in order to furnish additional data on this subject. Under these conditions the water should be distilled as slowly as practicable, while maintaining a holding time and temperature sufficient to kill all non-spore bearing pathogenic bacteria.

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## STORAGE OF POLLUTED WATER ON BOARD SHIP FOR ANY PURPOSE NOT RECOMMENDED

The outbreak of an acute intestinal infection on board the U. S. S. *Melville* attributed to Gatun Lake water calls attention to the use of this water on board naval vessels and to the efficiency of the low-pressure evaporators installed on many vessels of the Navy to produce a potable water under the most unfavorable conditions of operation.

In October, 1927, after the report of this outbreak had been received, the following letter was sent to the commanding officers of vessels known or presumed to have passed through the Panama Canal during the period March 1 to July 1, 1927:

During the maneuvers of the Scouting and Battle Fleets in the spring of 1927 an outbreak of actue gastrointestinal disease occured in some of the ships while in the Gonaives and Guantanamo Bay areas. Later a similar outbreak developed in another naval vessel. The medical officer traced the cause of this outbreak to water taken aboard from Gatun Lake while the ship was in transit through the Panama Canal.

In considering all the factors that might possibly have been operative in the first outbreak, it would be of interest to note any possible connection between the outbreak and water taken aboard from Gatun Lake.

It is therefore requested that this bureau be informed if any water from Gatun Lake was taken aboard the vessel under your command during the period March 1 to July 1, 1927, the amount and date on which the water was taken, and the treatment, if any, given this water.

Replies received in response to this letter from 102 naval vessels indicated that lake water varying in amount from 500 gallons to 107,200 gallons was taken aboard 52 ships, while replies from the remaining 50 stated that no water was taken from Gatun Lake.

The treatment given to this water and the purposes for which it was intended are given in the following table:

| Number of ships reporting | Amount | Purpose | Treatment |
|---|---|---|---|
| | *Gallons* | | |
| 1 | 7,000 | Drinking | None. |
| 21 | [1] 235,375 | Boiler feed | Do. |
| 3 | [2] 19,500 | do | Distilled. |
| 3 | Not stated. | Other than drinking or cooking | Not stated. |
| 1 | 25,000 | Not stated | None. |
| 19 | [3] 281,200 | All purposes | Distilled. |
| 1 | 15,000 | Boiler feed | None. |
| | 10,000 | Drinking | Distilled. |
| 1 | 7,000 | Boiler feed | Do. |
| | 15,000 | do | None. |
| 2 | Not stated. | Washing boilers, through flushing mains | Do. |
| 50 | ([4]) | | |

[1] Amount not stated in reports from 9 ships.
[2] Amount not stated in report from 1 ship.
[3] Amount not stated in reports from 3 ships.
[4] No water taken on board.

It will be noted from the above table that Gatun Lake water is used for boiler feed and, further, that it is taken on board, without purification, and stored in the boiler feed tanks of naval vessels while passing through the Panama Canal. A report from one ship, a destroyer, stated that 3,000 gallons were taken on board on March 5, 1927, and 4,000 gallons on May 12, 1927, for drinking purposes without purification. In this connection it is interesting to note that no admissions for a water-borne disease were reported by this destroyer during the year 1927.

A letter received from the chief health officer of the Panama Canal states that the water of Gatun Lake is subject to pollution from its watershed and obviously should not be used for drinking purposes at any time without proper treatment by means of heat, filtration, or chlorination. Water in the main ship channel is also subject to continual pollution from ships passing through the canal. A summary of the results obtained from bacteriological analyses of

numerous samples of water taken from various parts of Gatun Lake during the time period May to October, 1927, inclusive, appears in the following table:

| Source of sample | Quantities tested for Colon group | | | | | |
|---|---|---|---|---|---|---|
| | 10 c. c. | | 1 c. c. | | 0.1 c. c. | |
| | Number of tests | Number positive | Number of tests | Number positive | Number of tests | Number positive |
| Arm of Gatun Lake: | | | | | | |
| Source of supply for the Mount Hope filtration plant | 184 | 56 | 184 | 14 | 184 | 0 |
| Stillson's Pond; source of supply for the Agua Clara filtration plant | 184 | 86 | 184 | 39 | 184 | 7 |
| Gatun Lake at Monte Lirio | 26 | 5 | 26 | 1 | 26 | 0 |
| Gatun Lake at Frijoles | 27 | 9 | 27 | 4 | 27 | 0 |
| Gatun Lake at Darien | 27 | 8 | 27 | 2 | 27 | 1 |
| Total | 448 | 164 | 448 | 60 | 448 | 8 |
| Per cent positive of quantities tested | 36.6 | | 13.4 | | 1.8 | |

These results indicate a heavy pollution of all parts of the lake with microorganisms of intestinal origin.

While reports from any ships state that there is no connection between the feed tanks and the tanks which contain potable water, the presence of contaminated water in any fresh-water tank on board a ship having a possible physical connection with the potable water system constitutes, in a sense, a dual water supply, and is a distinct sanitary menace to the health of the crew.

In regard to a dual water supply, Rosenau (1927) states that "Even when the community served is intelligent and careful, the danger of a double system is very great, and it will probably never be resorted to except through stress of circumstances. Auxiliary water systems are often connected with the drinking-water mains, and controlled by means of check valves, by-passes, etc. This arrangement is hazardous and a number of outbreaks of typhoid fever have been traced to faulty valves or failure to close by passes in such a dual system. Twenty outbreaks due to these causes have been reported in the United States in recent years." Also, James T. B. Bowles, B. S., in the chapter "Water supplies and their purification" in Public Health and Hygiene, Park (1920), states that the objection to a dual system is that there is always a chance for the water from a questionable source to be used for drinking purposes, or possibly a chance for the good-water supply to be contaminated by the poor one. Such a system is not to be recommended except under extraordinary conditions.

The human element must always be considered whenever contaminated fresh water for any purpose is stored in any tank on board a

ship. The possibilities are ever present of some member of the crew making a mistake, such as in the number of the tank, and pumping contaminated water into the potable water system, of opening the wrong valve, of leakage through worn or improperly seated valves, or of transferring potable water through pumps or lines which had been used previously in carrying infected water.

That such an accident has actually occurred in the naval service is indicated in a report recently received from a naval tank ship. The report states that it is the custom on board this vessel to use Gatun Lake water taken on board during the transit of the Panama Canal for steaming purposes only. None of this water has been used for drinking purposes, except on one occasion when, by accident, the Gatun Lake water was pumped into the drinking-water supply from the steaming tanks. Because of the unpalatability of the drinking water at the time, this condition was immediately suspected by the medical officer and corrective measures started. It was stated that the storage of untreated water from Gatun Lake is therefore considered to be a constant potential danger. Fortunately no case of illness that could be attributed to infected water was reported by this ship as a result of this mistake.

It is therefore recommended that all fresh water from Gatun Lake or other source, where pollution is known or suspected, be disinfected by distillation in the evaporators at the time the water is taken on board or by concurrent immediate chlorination in the tanks by means of a solution of chlorinated lime.

When, under exceptional circumstances, polluted water is required for steaming purposes and it is not practical to distill all the water required, it is a comparatively simple procedure to disinfect the water by chlorination.

An instance to illustrate this point occurred to the writer while serving on board a transport during the World War. The transport had arrived at the port of La Bassens, France, located on the Gironde River about 9 miles below the city of Bordeaux, to discharge cargo and passengers. A considerable quantity of fresh water for steaming purposes was required for the return trip to the United States, and no water could be obtained from the shore. The engineer officer of the ship discovered that at high slack tide the water of the Gironde River was brackish and turbid but at low slack tide the water was clear and contained but a trace of salt. As Bordeaux was a city of approximately half a million inhabitants and, as far as could be determined, discharged most of its sewage into the river, the water was undoubtedly grossly polluted. Following a conference with the engineer officer, potable water was transferred from certain accessible tanks and they were filled with river water at low

slack tide. The mains through which the river water was pumped were then disinfected by means of steam. The capacity of each tank in gallons was obtained from the ship's plans and a solution of chlorinated lime, calculated to give 5 parts per million when added to the water, was introduced into each tank. Subsequent bacteriological examinations showed no gas formation, and no difficulty was experienced during the return trip in the use of this water for steaming purposes.

Chlorinated lime when freshly prepared contains approximately 30 per cent of available chlorine. It is an unstable compound and deteriorates with comparative rapidity even when kept in air-tight containers in a dry, cool place. It is supplied to the Navy in amber-colored bottles, tightly corked, and sealed with wax, tar, or other similar preparation. Samples purchased in Washington, D. C., during the past year have shown upon assay to have an available chlorine content varying from 8 per cent to 22 per cent. When chlorinated lime is employed to disinfect water it is safe to state that samples from each container should be assayed according to the method given in the United States Pharmacopœia and the amount to be used computed upon the available chlorine actually present as shown by the assay.

The amount of chlorinated lime determined for each tank should be added to a sufficient amount of water in a bucket or other suitable container, thoroughly mixed by stirring with a clean wooden paddle or other suitable implement, allowed to stand so that the inert insoluble particles may settle to the bottom. The supernatant fluid is then added to the water in the tank. This will obviate the addition of insoluble particles to the feed water with possible injurious effects to pipes, valve faces, boilers, and other metal surfaces exposed to the action of the chlorinated water. To facilitate rapid mixture of the chlorine solution with the water in case there is very slight or no motion to the ship, it is better to add the solution to a half-filled tank, agitate the contents if possible, and then to complete the filling of the tank. The amounts of chlorinated lime to be added and the manner of testing for free or residual chlorine after a holding time of 15 minutes are given in detail in article 2665 of the Manual of the Medical Department, United States Navy, 1927.

To determine the efficiency of the chlorination process, the standard American Public Health Association tests for the presence of members of the *B. coli* group of bacteria may be applied, without great difficulty, to the water after chlorination.

The amount of free chlorine required to destroy pathogenic microorganisms in water is so small that it is extremely doubtful if any

corrosive effect on metal surfaces would follow the employment of water so treated for steaming purposes. Many large cities in the United States disinfect their water supplies by the chlorine method without causing a noticeable increase in the corrosive action of the water when heated. It has been reported that on the west side of Berlin, where rapid rusting of boilers and heating coils has been observed, the water is not chlorinated.

Gillespie, 1920, in an article in the Engineering News-Record states that severe corrosion and graphitization of the cast-iron parts of the intake valves of the waterworks, Sacramento, Calif., were caused by pockets of undissolved chlorine gas which collected in the system from the chlorination of the water. All the metals found in the valves were attacked and, so far as examination disclosed, with equal severity. In some valves the brass stems seemed to have been attacked the more severely while in others the wrought iron gave way first, and in still others the cast iron had suffered the greatest deterioration. The attack was most severe near the point of application of the chlorine, but 60 feet or so away no corrosion was observed. At this point all traces of undissolved gas had disappeared.

According to the Water Works Practice Manual, 1925, the effect of chlorination on lead services was investigated by Houston in 1904, who found that chlorine as hypochlorite had no appreciable effect on the plumbosolvency of the treated water either filtered or unfiltered. Undoubtedly an excess of free chlorine or hypochlorous acid will cause increasing corrosion of hot water piping, tanks, etc. It has been shown that, in at least one instance, chlorinated water dissolved considerably less zinc from galvanized pipes and tanks than did the same water before chlorination.

The possibility of viable microorganisms being carried over with the water vapor as it passes from the evaporator into the condenser or distiller was discussed in the NAVAL MEDICAL BULLETIN, volume 22, No. 4, April, 1925, and volume 25, No. 4, October, 1927. There are insufficient data available at present definitely to settle this point. Many causes, among which may be mentioned priming resulting from too rapid evaporation of the water when fresh water is used for evaporator feed, may operate to carry water and contained bacteria along with the vapor. In this connection, a report from the U. S. S. *California* states that Gatun Lake water was used as evaporator feed on two different occasions while that vessel was passing through the Panama Canal. In each instance a high rate of evaporation was employed to take advantage of the low salinity of the water in the canal, and the total indicated evaporation was about 10,000 gallons

above the normal operation of the plant. All the water was boiled and at least partially evaporated.

The following extract from the annual sanitary report of the U. S. S. *Black Hawk* for the year 1925 gives the experience and opinion of Commander F. H. Haigler, Medical Corps, United States Navy, the medical officer of that vessel:

* * * To determine the potability of water distilled at this temperature a specimen was taken while the ship was anchored in the Whangpo River at Shanghai, and submitted to a local laboratory for culture. As is well known, the Whangpo River is one of the most highly contaminated streams of water in the world. It is unfortunate that no control culture of the river water was made. The laboratory reported the specimen sterile. The crew drank this water daily during the months of October and November, 1924, with no ill effects. It appears that water distilled in this manner is entirely safe.

Further comment contained in a recent letter received from Commander Haigler is as follows:

I have noted from time to time, with considerable interest, articles appearing in the NAVAL MEDICAL BULLETIN and the circular on health conditions in the Navy dealing with the potability of water aboard ships that has been distilled by the "low pressure vacuum distilling system."

As far as I am able to determine no one has, as yet, made a definite statement one way or the other as to the purity and safety of water thus obtained and I desire to relate briefly the results of an investigation which I undertook in conjunction with the chief engineer of the U. S. S. *Black Hawk* of the Asiatic Fleet while attached to that vessel. A statement bearing on this was incorporated in the annual sanitary report of that vessel for the year 1924.

During the months of September, October, and November, 1924, the *Black Hawk* was anchored in the Whangpo River opposite the French Bund in Shanghai, and the question of potability of the ship's water supply was immediately referred to the medical officer. As is well known by those familiar, there are few rivers which are as highly polluted as the Whangpo, and especially so during August and September when the cholera infection is at its height and an enormous amount of sewage is disposed of in the river from the old Chinese city situated above the then anchorage of the ship.

After consultation with the chief engineer it was decided to operate the evaporators carefully, not crowding them, so as to produce a condition known as "priming." I then collected daily specimens of water in sterile gallon bottles and took them immediately to a bacteriological laboratory ashore. These specimens were cultured and approximately 10 specimens (as I now recall) failed to show colon bacillus or other pathological growths. Also during this period of our stay in Shanghai the crew remained in good health and no member gave any signs of intestinal disease having been caused by polluted water.

Personally, I feel that polluted water distilled by the low pressure system is potable, provided the system is not crowded beyond its capacity.

Additional information on this subject is contained in the article entitled "Bacteriological examination of fresh water from ships' evaporators and tanks" by Lieut. J. G. Dickson, Medical Corps,

United States Navy, in this number of the BULLETIN, and in the following extract from the annual sanitary report from the U. S. S. *Cincinnati* for the year 1927:

During the entire stay of the ship in the Yangtze and Whangpo Rivers water from the ship's evaporators was chlorinated in the proportion of 1:3,000,000, using chlorinated lime usually obtained on requisition. This decision was reached after conference with other medical officers of the division. Vessels of this type are equipped with low-pressure evaporators in which a temperature of about 140° F., or less, is required to evaporate water in a vacuum or about 29 inches. There has been a question in the minds of medical officers who have had experience on vessels with this type of distilling plant, and the bureau's recent comment on the subject is recalled, whether polluted water could be sterilized by passing through a unit of this type. It is the opinion of this medical officer that it can; but due to mechanical causes water vapor may become saturated with polluted water molecules and forced into the distilling unit. This is apt to occur if the effects are forced in an effort to increase the output. The heat of the auxiliary exhaust steam utilized in the evaporating plant will range from 170° to 196° as it enters the first effect and will average around 140° as it passes through the second and completes its cycle. The plant in use on this vessel is the Lilly low pressure evaporating system and was installed in the plate of the high-pressure system called for in original specifications.

If such should take place, varying degrees of pollution occur, but usually not sufficient to cause symptoms in persons drinking it. It is fraught with exceeding danger—potentially, at least. At one time in North River, New York, a tank was "salted" in this way, and cultures at the naval hospital at that place showed the water to be sufficiently polluted to condemn it for drinking purposes. Such a possibility of pollution, however slight it may be, or great the dilution, if it would occur, was considered sufficient justification for the adoption of this measure to insure a pure water supply.

Samples of water were collected while at Shanghai in the early spring from each low-pressure effect of the distilling plant, the fresh water feed tanks and the line supplying outside water to the plant. Water as it left the plant was found to be free of all organisms of contamination in 120 mils; the fresh water feed tanks also were not polluted. Water taken from the first unit of the plant was found to contain over 5,800 coliform bacilli, 5,500 *B. coli* group, and 1,270 *B. aerogenes* to the liter. River water was not allowed on board for any purpose, the usual demands for fresh water for various purposes being supplied from the fresh water tanks.

It would seem desirable when water is being distilled under these conditions, or when water from a polluted harbor is used as evaporator feed, to apply the standard American Public Health Association tests for determining the presence of members of the *B. coli* group of bacteria, as outlined in the chapter "Bacteriological examination of water," Stitt, 1927, to samples of water obtained from the evaporators and ship's tanks, using as controls in each instance samples of water from over the side, and to make a report to the bureau of the results obtained.

## BACTERIOLOGICAL EXAMINATION OF FRESH-WATER SAMPLES TAKEN FROM EVAPORATORS AND TANKS ON BOARD SEVERAL VESSELS OF THE SCOUTING FLEET

By James G. Dickson, Lieutenant, Medical Corps, United States Navy

To gain additional information regarding the bacterial content of water distilled on board naval vessels and, at the instance of the Surgeon General, United States Navy, samples of fresh water were taken from the evaporator discharge lines and in a few instances from fresh-water tanks of 17 ships of the Scouting Fleet while they were at anchor in Guantanamo Bay, Cuba.

These samples were obtained under strict aseptic precautions and sent as quickly as practicable to the laboratory of the U. S. S. *Mercy* for bacteriological examination. The average length of time elapsing from the minute the samples were taken until the water was inoculated into culture media at the laboratory is estimated to have been about one hour.

In conducting this investigation the standard methods of water analysis of the American Public Health Association, as outlined in the volume entitled "Practical Bacteriology, Blood Work, and Animal Parasitology," Stitt, 1927, were followed as closely as possible. Two sets of litmus-lactose-agar plates were inoculated with amounts of water varying from 0.1 c. c. to 1.0 c. c. With water obtained from the U. S. S. *Arkansas*, *Utah*, *Wyoming*, and *Vestal*, in addition to inoculating plates with from 0.1 c. c. to 1.0 c. c., a portion of the sample was diluted and other plates inoculated with 0.2 c. c. of the diluted water equivalent to one-fiftieth c. c. of the original sample.

A count of all visible colonies in one set of plates was made, after an incubation period of 24 hours at 37° C., and in the other set after an incubation period of 48 hours at room temperature. In addition, 50 c. c. of water from each sample were inoculated in bulk into Durham's fermentation tubes containing lactose bouillon and Andrade's indicator, but in a few instances amounts less than 50 c. c. were inoculated in 10 c. c. portions. The broth cultures were examined at the end of 24 and 48 hours and acid and gas formation recorded.

The results, tabulated according to the type of each vessel from which samples were obtained, are given in the following table. Except as otherwise noted, the samples were taken from the water as it left the evaporators:

| Ship | Date | Bacterial count per c. c. | | Lactose broth, 37° C. | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 24 hours (37° C.) | 48 hours (room temperature) | Amount | 24 hours | | 48 hours | |
| | | | | | A | G | A | G |
| Battleships: | 1928 | | | c. c. | | | | |
| Florida | Feb. 27 | 608 | 1,306 | (5) 10 | – | – | – | – |
| Utah | Mar. 18 | 313 | 2,120 | 50 | – | – | – | – |
| Utah tank | ...do... | 880 | 19,350 | 50 | – | – | – | [1] – |
| Arkansas | ...do... | 560 | 1,700 | 50 | – | – | – | – |
| Arkansas tank | ...do... | 600 | 460 | 50 | – | – | + | [2] – |
| Wyoming | Mar. 21 | 3 | 8 | 50 | – | – | – | – |
| Wyoming tank | ...do... | 5 | 200 | 50 | + | – | + | [3] – |
| Auxiliaries: | | | | | | | | |
| Wright | Feb. 27 | 18 | 34 | (5) 10 | – | – | – | – |
| Sapelo | Feb. 28 | 1 | 4 | (4) 10 | – | – | – | – |
| Vestal | Mar. 1 | 88 | 1,100 | (3) 10 | – | – | – | – |
| Cruisers: | | | | | | | | |
| Trenton | Mar. 2 | 0 | 3 | 50 | – | – | – | – |
| Memphis | Mar. 3 | 2 | 0 | 50 | – | – | – | – |
| Concord | Mar. 11 | 3 | 20 | 50 | – | – | – | – |
| Destroyers: | | | | | | | | |
| Smith Thompson | Feb. 29 | 0 | 0 | 50 | – | – | – | – |
| Whipple | ...do... | 0 | 0 | 50 | – | – | – | – |
| J. D. Edwards | ...do... | ? | ? | 50 | – | – | – | [4] – |
| Borie | ...do... | 0 | ? | 50 | – | – | – | [5] – |
| Tracy | ...do... | 0 | 0 | 50 | – | – | – | – |
| Barker | ...do... | 0 | 0 | 50 | – | – | – | – |
| Preston | Mar. 1 | 0 | 13 | (5) 10 | – | – | – | – |

[1] Specimen in tank 7 to 8 days since distillation.
[2] Specimen in tank 3 days since distillation.
[3] Specimen in tank 2½ days since distillation.
[4] Both 37° C. and room-temperature plates showed only one colony in 0.5 c. c. plates; none in 0.2 and 0.3.
[5] All 37° C. plates negative; room-temperature plates showed one colony in 0.3 c. c. plate; 0.2 and 0.5 negative.

In the above table it will be noted that no control tests were made with samples of Guantanamo Bay water from over the side. This was thought of several times but was considered superfluous as excreta in visible quantities was always observed about each ship.

None of the microorganisms found in the samples of water from the various ships were identified because of the lack of sufficient time to perform the required laboratory procedures. In no instance, however, were colonies of the *Bacillus coli* found in the litmus-lactose-agar plates. While acid production was observed three times in two different samples, no gas formation was noted in any of the tests.

### SUMMARY AND CONCLUSIONS

Water direct from battleship evaporators, except that from U. S. S. *Wyoming*, showed high bacterial counts. This can not be accounted for except on the ground that living bacteria came over in the distillate. Just how this takes places remains to be shown. In three instances samples of water from tanks of battleships were also examined and showed higher counts than the samples from the evaporators, except that from one of the tanks of the U. S. S. *Arkansas*, which showed a lower count in the plates inoculated for 48 hours at room temperature.

Samples from the *Utah*, *Wyoming*, *Arkansas*, and *Vestal* were diluted to obtain more accurate counts, as plates inoculated with portions of the undiluted sample had been examined at a previous time and found to contain too many bacteria for an accurate count. In each instance, however, the culture with 50 c. c. of the sample was negative for gas in lactose broth.

Water from the evaporators of the *Sapelo* and of the *Wright* showed low counts and may be considered satisfactory, especially the former. Specimens from evaporators of the *Vestal* showed high counts. Living organisms are presumably coming over in the distillate of evaporators of the *Vestal.*

Samples from the evaporators of cruisers and destroyers, especially the latter, were found to be almost sterile, the number of colonies found being entirely too few for an accurate count.

Samples from destroyers in two instances, the U. S. S. *Smith Thompson* and the U. S. S. *J. D. Edwards*, showed no apparent growth in 48 hours, with 50 c. c. amounts in lactose broth. In all samples from destroyers, except the U. S. S. *Preston*, it required 48 hours before lactose broth cultures, with 50 c. c. amounts, showed any apparent growth.

It is of the greatest importance and interest that in not a single instance was gas found in lactose broth at the end of 48 hours, constituting uniformly negative tests for *B. coli.*

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## SURFACE POLLUTION OF THE WATER SUPPLY AT THE UNITED STATES NAVAL STATION, TUTUILA, SAMOA

By J. R. PHELPS, Commander, Medical Corps, United States Navy

The source of the water supply of the United States Naval Station, Tutuila, American Samoa, is rain water collected on a watershed located in the near-by mountains. The watershed consists of the sides of adjacent mountains which extend to an elevation of 2,141 feet above sea level and are covered with a dense growth of tropical vegetation and trees. The geological formation consists chiefly of lava and other volcanic rock covered by a tropical soil which is for the most part very porous.

From the watershed the surface water finds its way rapidly into the impounding reservoir in the course of hours rather than days. It flows into what is known as the upper reservoir by two routes, one of which is a surface stream formed by two, and during periods of heavy rainfall probably by several, mountain streams. These separate sources combine to form a single stream a short distance above the reservoir.

A survey of this stream recently by the public works department disclosed a large mass of rock which probably had fallen in a landslide. The rock was in and over the stream and formed what might be termed a cave, varying in width from 3 to 5 feet, and in height from a few to about 20 feet. Several hundred belfry bats were found in the interior of this cave under such conditions that practically all their excrement entered the stream. This particular shelter for bats has been eradicated by blowing up the rock with dynamite. A sample of water from the stream above this slide was found to be heavily polluted with colon bacilli.

Besides this stream a comparatively large proportion of the water enters the reservoir through a spring discharging under the water at the upper end. The water outcrops at an elevation of 17 feet above the bottom of the reservoir, which has a depth of about 33 feet at the deepest part. So far it has not been practicable to obtain a sample of water from the spring itself for bacteriological examination.

This upper reservoir has an elevation of about 813 feet above sea level and is a natural enlongated depression or valley between mountain peaks which has been closed at one end by the construction of a dam. It holds about 1,720,000 gallons when filled. The water in the reservoir is usually very turbid to muddy and is said to be as thick as pea soup at times of lesser rainfall. There is an abundant growth of green algæ, which, however, does not impart a disagreeable taste to the water. Due to the positions of near-by mountain peaks the sun does not at any time shine directly upon the reservoir. The suspended matter is practically all heavy and settleable, but very little time is usually had for sedimentation, because large quantities of water are withdrawn daily for as many hours as possible in the operation of a hydroelectric plant, and also because of the sudden entrance of large quantities of water during and following heavy rains, which frequently cause the reservoir to overflow in the course of a few hours. Also, torrential rains occur frequently, often several times a day, especially in the rainy season, during which a considerable quantity of vegetable matter is carried into the reservoir.

From the upper reservoir the water flows by gravity through an iron pipe line, which is for the most part 12 inches in diameter. This line has been constructed with commendable engineering skill. It winds around mountain sides to a point where it drops sheerly to the hydroelectric plant located at a point 206 feet above sea level. Right beside the plant there are two small distribution reservoirs. One, called the back reservoir, has a capacity of 252,000 gallons, and the

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other, the front reservoir, has a capacity of 190,000 gallons. Water can be passed to service separately from either reservoir and likewise to waste into a ravine. The front reservoir can be filled from the back reservoir or directly from the hydroelectric plant.

Unfortunately the back reservoir is fed by two small streams, which bring in water from a comparatively low area, traversed by Samoans passing to and fro between their habitations and plantations. Wherever Samoans pass it may be assumed the soil is liable to pollution with human feces. There is also the likelihood of contamination by rats and pigs. During and after heavy rainfall these streams become greatly swollen and others appear, so that not infrequently the back reservoir overflows, the excess water running into a ravine through sluiceways of concrete built for the purpose. In view of these conditions it is apparent that the back distribution reservoir is subject to a pollution potentially more dangerous in character than that in the upper reservoir, which receives water high up in the mountains, where there are no human habitations and where the watershed is probably not traversed by human beings or larger animals. It has been said that rats do not live on the upper watershed, but in view of the heavy contamination with colon bacilli it would seem that rats or other animals are present. It seems doubtful if the pollution can be accounted for entirely by bats and birds.

As determined by testing a bucketful of the heavily polluted water, the self-purification time is 12 days, after which all portions tested prove negative for members of the *B. coli* group. Under operating conditions, water from the upper reservoir reaches the consumer in from 1 to 3 or 4 days.

The water supply of the station is adequate as to quantity at all times but the quality is not good either physically or bacteriologically. Since the writer reported for duty on November 30, 1927, the water has frequently shown much greater turbidity than would be tolerated in a public water supply in the United States. The turbidity has ranged from less than 20 parts per million when the water was clear to definitely muddy water which has flowed not infrequently from taps in all parts of the station.

It appears that previously it was the custom to test the water once every three weeks, but that the Standard American Public Health Association methods were not used. Reports on file indicate that sometimes colon bacilli were found and that at other times the water gave negative tests also that at times the water was considered fit for drinking purposes without boiling, and at other times boiling was recommended. In January the laboratory division of the medical department was reorganized and placed under the competent management of Chief Pharmacist's Mate A. W. Jones, who received his special training in the laboratories of the

United States Naval Medical School, Washington, D. C., and has since had much experience in both chemical and bacteriological work.

Early in January, before the laboratory was quite prepared to undertake daily bacteriological control of the water, standard samples were taken on three successive days, and it happened that all samples were negative for members of the *B. coli* group. Again, on January 21 and 22, tests were negative, but on the third day, or January 23, gas appeared early and in large volume (50 per cent) in all the five standard 10 c. c. portions of tap water tested that day. Large numbers of colon bacilli have been present in the water daily ever since, even in portions of water as small as one one-hundredth of 1 cubic centimeter.

On January 24 it became apparent that there was a large leakage from the back into the front reservoir. The back reservoir was accordingly emptied and a few days later repairs were made. It appears that a certain amount of leakage from the back into the front reservoir must be taken into account. In constructing these reservoirs, apparently, difference in quality of the water contained in them was not contemplated. The connecting pipe line has a single valve which can not be regarded as leak proof, but this in itself is not important, inasmuch as there is almost certain to be leakage otherwise.

To complete the bacteriological evidence, all tests for complete confirmation and identification of the colon bacillus have been made, and there is no doubt that we are dealing with a microorganism of animal origin. Cultures have a pronounced fecal odor and cultures on Endo's medium and Teague's medium were typical. Separate colonies upon further cultivation on agar showed actively motile, Gram negative, nonspore-bearing bacilli. Colonies from an agar slant were grown in dextrose broth and yielded 50 per cent of gas by volume within 24 hours. A standard test for indol production was positive, the methyl red test was also positive, and the Voges-Proskauer reaction was negative, as is to be expected with the colon bacillus of human or animal fecal origin. Litmus milk was acidified and coagulated but there was no liquefaction of gelatin. For additional confirmation, freshly passed human feces were cultured and the colon bacilli obtained therefrom gave identical results with the microorganism cultured from the water with respect to all tests mentioned above.

The estimate of the water situation is that the water supply, from the source to spigots, will continue to be heavily contaminated with colon bacilli most of the time, in the future, with brief periods only during which negative presumptive tests for members of the *B. coli* group will be recorded. Instructions to boil the water have been

published from time to time by the Governor of American Samoa but doubtless native Samoans, for the most part, are not boiling the waters, and doubtless, too, some white persons drink unboiled water in their homes, offices, and shops.

The ice manufactured from the water without distillation or boiling was, of course, presumably heavily polluted, so on January 27, 1928, a piece of ice was melted and cultured. As small a portion as one one-hundredth of 1 cubic centimeter yielded a trace of gas in less than 24 hours and larger portions yielded from 5 to 25 per cent by volume.

The public works officer cooperated fully and promptly to provide ice of potable quality. An apparatus consisting of a coil connected with a water tank was designed to be heated with a powerful kerosene torch which, fortunately, was available on the station. Tests controlled by thermometers and bacteriological examinations showed that ice uniformly free from living colon bacilli and non-sporebearing disease-producing microorganisms could be had. In practice the water was heated in the coil to about 206° F. In the course of from 3 to 3½ minutes the temperature fell to 160° F. as the water mixed with cooler water in the tank, and after leaving the tank the temperature remained above 145° F. for more than 30 minutes. More recently it has been found that the water used to cool the heavy Diesel engine in the central electrical power plant, and which formerly ran to waste, is suitable, with respect to physical and chemical properties, for the manufacture of ice. The supply is so great that all the water to be used in making ice for a period of 24 hours can be run into tanks for cooling in less than one hour in the forenoon without employing additional personnel. Consequently the water is heated without cost.

The temperature of the water is controlled so that the temperature shall at no time fall below 152° F. when it enters the small tanks of 300 pounds capacity each, which are used for holding the water until it has cooled. The minimum temperature permitted is 152° F. Under existing atmospheric conditions the time for cooling to 145° F. is 38 minutes. In practice the temperature of the water is seldom less than 160° F. when it enters the holding tanks, consequently the water is Pasteurized with a large additional margin of safety.

The medical officer has recommended that steps be taken without delay to procure standard modern apparatus for the chlorination of water in the main pipe line just after it has left the lower reservoir, with chlorine gas under sufficient control for the accurate regulation of dosage at all times. It is understood that the public works officer has prepared and submitted the necessary data with a view to securing action by the Navy Department.

It should be remembered in this connection that the application of chlorine gas to a raw, polluted, and often turbid water, is at best an emergency treatment which can not merit the sanitary approval given to a filtered water to which chlorine gas is added as a final treatment merely as an additional safeguard.

Inspection of the land available in the vicinity of the lower reservoirs shows no place where slow filtration sand beds could be constructed at a reasonable cost. It probably would be practical to construct a rapid sand filtration plant of either the pressure or gravity type near the hydroelectric plant and lower reservoirs. Consideration should be given to this question, in view of the fact that no municipality in the United States under competent public health administration would consider the use of such water satisfactory without filtration. If a gravity type rapid filtration plant were provided, an additional holding reservoir would be required, and such a reservoir might be necessary with pressure filters for equalization between the supply and demand for water.

While not conforming to standard modern waterworks practice, it is probable that a water nearly always clear to the eye, can be obtained almost constantly by using the back lower reservoir as a sedimentation basin and passing the water through a filtration tank or chamber containing sand and gravel, on its way to the front reservoir. The public works officer is experimenting with a view to constructing such a filter. With chlorination in the service main, a water of much better quality than that supplied at present could undoubtedly be furnished the naval station. Without chlorination there is considerable danger that pathogenic microorganisms will at times enter the water by drainage into the lower back reservoir from the potentially dangerous lower watershed mentioned. For a few days the back reservoir was kept empty as that practice would overcome this particular menace. It appeared, however, that the upper reservoir was frequently drained after operating the hydroelectric plant for several hours, especially at night. The need for fire protection demands that water be kept in reserve at all times in the back reservoir. Accordingly there will be a real menace to health until the water delivered for human consumption is chlorinated.

## THE CONTROL OF MALARIA AND MOSQUITO BREEDING AT THE MARINE BARRACKS, QUANTICO, VA., DURING THE YEAR 1927

By W. M. Garton, Captain, Medical Corps, United States Navy

The control of malaria and mosquito breeding has been a major problem at the marine barracks, Quantico, Va., since this post was established in 1917. During the season of active mosquito breeding

it has been found necessary for the medical officer, Lieut. Commander S. S. Cook, Medical Corps, United States Navy, detailed as sanitary officer, to devote practically his entire attention to this work and has had little time for other activities.

At the close of the breeding season for the year 1926, a plan of organization was drawn up and the work outlined for the ensuing year. It was hoped that this plan could be put into operation, but the departure of a large number of troops for Nicaragua and China early in 1927 greatly interfered with the consummation of these plans. Following the departure of the troops, the work of the sanitary department appeared to be actually increased to some extent. The personnel at the post was so diminished in numbers that men were not available for essential sanitary measures, including the cutting of weeds and grass, the clearing of ditches, and as inspectors to discover water leaks, collections of water, and other sources of mosquito breeding in and about the vacant barrack buildings.

For many years, in fact long before land at Quantico was secured for marine barracks, the little village on the Virginia shore of the Potomac River about 40 miles south of Washington, D. C., had the reputation, according to the older inhabitants, of being the "worst hole for malaria on the Potomac." In recent years, however, due to an intensive campaign of mosquito and larva destruction, including the employment of the airplane for the application of Paris green and oil mixtures to extensive mosquito breeding areas, the admission rate as shown in the following table has been reduced from 28.26 per 1,000 in 1922 to 0 in 1927:

| Year | Average strength | Number of admissions | Rate per 1,000 | Year | Average strength | Number of admissions | Rate per 1,000 |
|---|---|---|---|---|---|---|---|
| 1922 | 4,388 | 124 | 28.26 | 1925 | 3,386 | 28 | 8.27 |
| 1923 | 4,028 | 48 | 11.92 | 1926 | 4,070 | 3 | .74 |
| 1924 | 3,791 | 30 | 7.91 | 1927 | 1,714 | 0 | .00 |

As shown by the above table, malaria has gradually decreased in Quantico, and in 1927 there were no original admissions.

A number of men were surveyed on account of malaria contracted in Nicaragua and returned to the United States. They were promptly isolated upon their arrival at Quantico and no spread of the disease resulted.

The organization of the medical department for mosquito-control work was essentially the same for 1927 as for the preceding year. A chief pharmacist's mate was placed in charge of the field work. His duties comprised the supervision of the district inspectors and of the men engaged in application of larvicides to collections of

water. He also had charge of the procurement of supplies for the field forces.

The reservation was divided into three districts with a pharmacist's mate as inspector in charge of each district. His duties consisted of the following:

(*a*) Inspection of his district for mosquito breeding.

(*b*) Application of oil to small pools and water containers.

(*c*) Collection of mosquito larvæ from the different types of breeding places found in his district.

(*d*) A report when drainage was needed, or when any large areas which required oiling were found.

(*e*) Supervision of men engaged in oiling while working in his district.

(*f*) Daily and weekly reports of the work accomplished and the amount of oil used.

The laboratory and office work were handled by a hospital corps man. He identified the specimens brought in by the field force, tested the oil for toxicity and filming qualities, and filed the reports and correspondence.

Two half-ton motor trucks were furnished by the post quartermaster. One of these was used in transferring the oiling squad and their equipment and the other as transportation for the post sanitary officer. Also, through his interest, a 16-foot, flat-bottomed boat equipped with an outboard motor was furnished for use in Quantico and Chopawamsic Creeks, and it proved ideal for the purpose.

As in 1926, the United States Public Health Service cooperated in our campaign by detailing inspectors from their "Field force for the study of malaria." Four sanitary inspectors were assigned to duty at Quantico, two of whom were employed in studying the control methods used at Quantico and Chopawamsic Creeks, and the other two in similar work at Aquia Creek. Aquia Creek, which is located about 4 miles south of the reservation, was used, as in 1926, as a control of the work at this post. The United States Public Health Service rented a truck for the two inspectors at Quantico and a boat for those at Aquia. Surg. L. L. Williams, jr., United States Public Health Service, who is now the director of the field forces for the study of malaria, was constantly in touch with the campaign and spent considerable time at Quantico. His wide and intimate knowledge of malaria control, together with his enthusiasm and his genuine interest, have helped greatly toward the success of this work.

Marines performed the work of oilers and when time permitted were employed in cutting grass, clearing ditches, and other necessary antimosquito procedures.

Active preparation for the year's work started on February 26, 1927. Ditches were opened, new drains put in, and the swamps burned over. Available storage for used crank-case oil was prepared for the season's use and additional storage constructed. This work continued until April 26, when oiling operations were begun. Due to shortage of men it was not found practicable to do any considerable amount of drainage after this time. Oiling was continued whenever and wherever breeding was found until October 13, when all work was discontinued on account of cold weather.

The mixture of oil usually employed was one part used crank-case oil to five parts kerosene with the addition of 1 per cent castor oil. Early in the season a much smaller proportion of kerosene was used, but this did not prove effective. Laboratory tests were done on varying proportions of kerosene and crank-case oil, which convinced us that extremely large quantities of used crank-case oil were necessary in order to obtain good results. In other words, the used crank-case oil had very little tendency to form a good film. In order to obtain satisfactory control of breeding with it we found it necessary to apply a very thick film to the water surface.

The amount of oil used for the season is indicated in the following table:

| | Gallons |
|---|---|
| Kerosene oil | 3,589 |
| Used crank-case oil | 946 |
| Castor oil | 50 |

The castor oil was obtained from the surplus war stock of the Army Air Service at no cost to us except the freight.

The oil was usually applied with knapsack sprayers known as the Panama or Meyer type. In a few places where there were temporary pools, oil-soaked sawdust was used. It has not been found necessary or desirable, at any time, to use drip cans.

Early in June seven experimental flights were made, using oil distributed by means of an airplane. Combinations of kerosene and castor oil; kerosene, Paris green, and castor oil; and fuel oil, Paris green, and castor oil were experimented with. This work had to be stopped in order to start the control of active breeding. It is not planned to continue experiments along these lines during the coming season. While it was not possible to reach any definite conclusion, it is considered that there is a field, particularly on the salt marshes, for the use of this method.

Quantico Creek in the northern section of the reservation and Chopawamsic Creek in the southern section, covering an area of approximately 800 acres, are the two large areas in which extensive mosquito breeding usually takes place. To quote from a report by the late Dr. H. R. Carter, 1918—

In these creeks there was the heaviest breeding of anopheles I have ever seen over a large area, and we estimated the average per dip at 8, but 1 dipper took 52. The same conditions had been noted on Broad River, S. C., and in other places in our work, but none so spectacular as this. This problem of breeding is a very difficult one.

These two creeks are covered for the most part with thick water vegetation interspersed with heavily wooded swamps and areas of open water. This vegetation consists of lily pads, lotus, and wild celery, sometimes called eel grass. Toward the end of July some of this vegetation tends to die and rise to the surface, where it forms mats of flotage. Excellent places for the development of mosquito larvæ are found in these mats, where the larvæ are protected from predatory fish, their natural enemies.

During the year 1927 mosquito breeding in Chopawamsic and Quantico Creeks was controlled by Paris green distributed by airplane. The plane used, known as an NB-2, has a low landing speed, is easily maneuvered, and proved to be very satisfactory. The plane carried an average load of 300 pounds and generally flew at approximately 60 miles per hour. Lieut. F. G. Cowie, United States Marine Corps, designed the dusting apparatus, which consisted of a hopper of 20 gauge brass, 30 inches high, 25 inches wide, and 30 inches long. The hopper was placed in the after cockpit and was equipped with a cable outlet control which was carried forward to the pilot's seat. The outlet measured 7½ by 9½ inches and was fitted with a sliding door held in the closed position with stop bolts. The cable control terminated in a handle which was placed so that it could be easily reached by the pilot. This handle was mounted so as to slide on a bar and permitted the regulation of the opening in the hopper to any degree. No agitator was found to be necessary within the hopper. The dust fell by gravity to the venturi tube mounted beneath the fuselage where it was blown out of the tube in an even cloud well broken up. The cost of the hopper was $93.85 installed.

Anopheline breeding in the eel grass mats of Quantico and Chopawamsic Creeks began almost two weeks earlier this year than last. The breeding in Chopawamsic Creek occurred in small areas at first and was found mainly along the channel. These areas were treated by oil distributed from a boat, and the application of Paris green by airplane withheld until early in September, when breeding was found to be generally distributed over the whole of the lower end of the creek. The Paris green mixture was then applied by airplane on September 13, 22, and 28. On the other hand, the breeding in Quantico Creek was widely distributed when first discovered, so that airplane dusting was started immediately. Flights were made over this section and the breeding areas dusted on July 21, August 1, 11, 22, 29, and on September 13 and 27.

It was concluded, at the end of the 1926 season, that 1 pound of Paris green per acre was the proper amount to use. Study of the results obtained in the season just closed demonstrates that this is the correct amount. The most satisfactory dilution of the dust has been found to be 33 per cent by weight.

The same diluent, powdered soapstone or Alberene, was used both years. At the beginning of the season it was decided to use the same check that was used in 1926, namely, pan lines and slides across the areas; adult roosting catches at selected points near these areas; the effect of dusting on the larval infestation of the area; and comparison of the adult and larval catching records at Aquia Creek, where no mosquito control work was being done, with those at Quantico and Chopawamsic Creek. It may be said briefly that a study of the results obtained from these checks indicated a satisfactory control through the method employed.

The amount and cost of the materials used during the year 1927 are given in the following table:

| | |
|---|---|
| Paris green, 3,150 pounds | $532.00 |
| Soapstone, 5,800 pounds | 29.00 |
| Total cost of material | 561.00 |
| Number of acres of breeding surface | 800 |
| Cost of material per acre per season, 1927 | $0.70 |
| Cost of material per acre per season, 1926 | $0.72 |
| Cost of hopper installed | $93.85 |
| Number of gallons of cylinder oil per hour | 1 |
| Number of gallons of gas per hour | 20 |
| Number of acres dusted during 1927 | 5,700 |
| Number of hours of dusting flights | 15¾ |
| Number of acres dusted per hour | 364 |

It will be noted from the above table that the cost of materials per acre per season was $0.70 as compared with $0.72 for the year 1926.

On July 7, Prof. N. H. Swellengrebel of the University of Amsterdam, a member of the health section of the League of Nations, and Surg. Gen. Hugh S. Cumming of the United States Public Health Service, visited Quantico. Two demonstrations were given for these visitors, one for the purpose of showing the distribution of Paris green, and the other, the distribution of oil and Paris green by airplane. On July 10 another demonstration was given for Professor Swellengrebel, during which it was shown that Paris green, when distributed by airplane, would effectively penetrate exceedingly dense vegetation.

Some experimental flights had been planned for Aquia Creek at different times during the season, but the lateness of the breeding in this creek prevented the making of intensive studies there as was planned. However, two flights were made, both of which furnished valuable information.

The scientific aspects of airplane control in Chopawamsic and Quantico Creeks have been reported in two articles by the sanitary officer of this post, Lieut. Commander S. S. Cook, Medical Corps, United States Navy. The first article appeared in the Public Health Reports of February 18, 1927, pages 459 to 480, under the title "Paris green applied by airplane in control of anopheles production." The other was read before the National Malaria Committee at Memphis, Tenn., November, 1927.

Inasmuch as no record in the files of this station were found showing the species of mosquitoes likely to be encountered here, considerable time was spent during the past two years investigating this phase of the work. In all, 28 species of mosquitoes have been found and identified. Not all of these species were found breeding here. Some of them were captured in the adult stage only.

The following table gives a list of the mosquitoes caught on the reservation and identified during the year 1927.

| | |
|---|---|
| Anopheles: | |
| Quadrimaculatus | Say, 1824. |
| Punctipennis | Say, 1823. |
| Crucians | Wiedermann, 1828. |
| Barberi | Coquillett, 1903. |
| Walkeri | Theobald, 1901. |
| Aedes: | |
| Vexans | Meigon, 1830. |
| Canadenia | Theobald, 1901. |
| Trivitattus | Coquillett, 1902. |
| Triseriatus | Say, 1823. |
| Sollicitans | Walker, 1856. |
| Taeniorhynchus | Wiedermann, 1821. |
| Atlanticus | Dyar and Knab, 1906. |
| Culex: | |
| Pipiens | Linnaeus, 1758. |
| Leprincei | Dyar and Knab, 1907.[1] |
| Territans | Walker, 1856. |
| Testacus (now Culex apicalis) | Adama, 1903. |
| Salinarius | Coquillett, 1904. |
| Tarsalis | Coquillett, 1896. |
| Psorophora: | |
| Howardi | Coquillett, 1901. |
| Columbiae | Dyar and Knab, 1906. |
| Ciliata | Fabricius, 1794. |
| Discolor | Coquillett, 1903. |
| Mansonia pertubans | Walker, 1856. |
| Orthopodomyia signifer | Coquillett, 1896. |
| Uranotaenia sapphirina | Osten Sacken, 1868. |
| Megarhinus septentriolanis | Dyar and Knab, 1907. |

Of the anophelines found *Anopheles quadrimaculatus* and *Anopheles punctipennis* were the most common. In fact, *A. punctipennis*

[1] This will be made a synonym of *Culex inhibitator*, Dyar and Knab, 1906.

have been found throughout the year. They breed early and late during the season and on warm days in winter adults can usually be found in favorable roosting places, in contrast to *A. quadrimaculatus* which were found principally in the summer months. With the latter species the breeding did not start until late in July and ceased early in October, constituting, without doubt, the most important species with which we have to deal. In addition to being our most important potential malaria vector they have proved troublesome at times as a pest. The other anophelines, namely, *crucians*, *barberi*, *walkeri* did not prove to be significant.

Of the Aedes found, the *Aedes vexans* was the most common as well as the most troublesome. While they were not found in any number in quarters, they were annoying at times on lawns and in the woods. Other species of the genus aedes found were *A. canadenis*, *A. trivitattus*, *A. triseriatus*, *A. sollicitans*, *A. taeniorhynchus*, and *A. atlanticus*, none of which were troublesome at any time.

Of the genus Culex, *C. pipiens* was the species most commonly found and proved to be the principal breeder in water containers.

Of the genus Psorophora, *P. howardi*, *P. columbiae*, *P. ciliata*, and *P. discolor* were found in July, August, and September of both 1926 and 1927.

Of the other genera, *Mansonia pertubans*, *Orthopodomyia signifer*, *Uranotaenia sapphirina*, and *Megarhinus septentrionalis* were occasionally found.

During the present year a more general and systematic sanitary program will be undertaken, but having in mind the beginning of the construction of new barracks contemplated this year, it is felt that further investigation will have to be undertaken either elsewhere or at a later date when the barracks are completed.

### CONCLUSIONS

(1) 33 per cent Paris green in an inert dust is the most satisfactory strength under all wind conditions.

(2) One pound of Paris green per acre is the proper unit.

(3) Material cost approximately $0.70 per acre per season.

## MOSQUITO CONTROL ON THE ISTHMUS OF PANAMA

Local conditions largely determine the methods to be employed in any given place for the control of mosquito propagation and malaria. The following paragraphs reprinted from the report of the health department of the Panama Canal for the calendar year 1926 are interesting and indicate that better results were obtained in sections of the Canal Zone through the use of oil than could be expected from

the application of Paris green mixed with road dust, soapstone, or other dry diluent:

"In the year 1926 the rate of infection with malaria among canal employees touched the lowest point ever reached since the United States began operations on the Isthmus, as shown in the following table:

*Admission rate from malaria, employees only*

| Year | Average number employed | Rate per 1,000 | Year | Average number employed | Rate per 1,000 |
|---|---|---|---|---|---|
| 1906 | 26, 547 | 821 | 1917 | 32, 589 | 14 |
| 1907 | 39, 238 | 424 | 1918 | 25, 520 | 18 |
| 1908 | 43, 890 | 282 | 1919 | 24, 204 | 31 |
| 1909 | 47, 167 | 215 | 1920 | 20, 673 | 19 |
| 1910 | 50, 802 | 187 | 1921 | 14, 389 | 15 |
| 1911 | 48, 876 | 184 | 1922 | 10, 447 | 17 |
| 1912 | 50, 893 | 110 | 1923 | 10, 976 | 19 |
| 1913 | 56, 654 | 76 | 1924 | 11, 625 | 16 |
| 1914 | 44, 329 | 82 | 1925 | 12, 180 | [1] 27 |
| 1915 | 34, 785 | 51 | 1926 | 12, 732 | 14 |
| 1916 | 33, 176 | 16 | | | |

[1] Rate would be only 16 if cases from Bruja Point are omitted.

"While malaria-carrying anopheline mosquitoes vary in numbers from one year to another (as a result of diverse meteorological conditions and, possibly, other factors yet unknown), it is probable that this lowest malaria rate is due chiefly to the great extensions and improvements in the sanitated areas which have taken place in recent years and to the greater ease with which mosquito control is now carried on within these areas. Concrete-bottomed ditches and subsoil tile drains have enormously simplified the maintenance of the drainage systems by which mosquito breeding is prevented.

"In the vicinity of the Pacific side cities of Balboa, Ancon, and Panama large hydraulic fills, made in past years and now well grassed over, presented extensive flat areas that were most troublesome to control by earth ditches dug in an unstable soil and of necessity having a low grade. In the part of the fill nearest to Balboa many small garden plots had been assigned to colored employees, and these were so poorly drained that almost constant observation and oiling were required to prevent the development of mosquitoes in them. In this part of the fill the main ditches of the system were reconstructed during 1926, precast sectional half-round concrete bottoms being installed with a grade of one-tenth per cent and at an average depth of about 3 feet. Necessary laterals of rock-covered 6-inch tile were placed at a depth of 30 inches and a grade of three-tenths per cent. Much of the former network of surface ditches was abandoned and filled, yet the better subsoil drainage achieved by this deepening of the remaining drains resulted in a practical drying up of the whole surface of the area.

"In the Panama suburban district, which includes the environs of the city of Panama within the Republic of Panáma, many ditches and brooks were converted into subsoil tile and sectional concrete-bottomed drains; among these was the small stream known as the Rio Tumba Muerta, with its tributaries. During the wet season the savannas within and about the Panama Golf Club were drained by open-earth ditches, a piece of work which extended mosquito control in that direction to a distance of over a mile beyond the line which had been controlled previously, or about 2 miles beyond the limits of the city proper.

"On the Atlantic side many new ditches were installed in the low-lying, swampy cattle pastures, between Mindi and Mount Hope. These ditches do not completely dry the land, but they do admit the tidal fluctuations and also so lower the water level as to render the water more foul and far less fit for breeding *Anopheles*. Through the mangrove swamps along the Panama Railroad south of Mount Hope a number of 4-feet wide sea-level canals were dug in order to establish freer circulation of salt water between the old French canal and the east diversion. Frequent and thorough search of these areas indicates that mosquito control is almost complete in them.

"In the Pedro Miguel district it has been found after long observation that oiling of the shore line of the several inlets to Miraflores Lake (over 25 miles in extent) is best accomplished at regular intervals, 10 days being set as the proper time between oilings, although longer intervals might be satisfactory. Some sections of this lake, notably the large, grass-filled shallow inlets of small rivers, might seem especially favorable for control of *Anopheles* breeding by means of Paris green after the method described by Barber and Hayne,[2] but conditions peculiar to the Canal Zone make the use of oil for this purpose the method of choice.

"The proper use of Paris green demands that it be diluted with a powdered material in the proportions of about 1 part of the poison to 100 parts of the diluent, perfect dryness being a prerequisite. In most places road dust is used as the diluent, although sand, ashes, flour, soapstone, sawdust, and other materials are also mentioned as satisfactory. It must be remembered that outside the Tropics the period of *Anopheles* breeding falls in the short warm season of the year which is not characterized by the relatively excessive rainfall that occurs during the season of maximum breeding on the Isthmus. 'Road dust' as it is known in the States not does exist here, nor does any other dry dust in a natural state, especially during the long rainy season. Even were a dry dust provided, special and expensive

[2] U. S. Public Health Service, Public Health Reports, vol. 36, pt. 2, Dec. 9, 1921, pp. 3027–3034.

precautions must be taken during the wet season to keep it in a condition of proper dryness until broadcast upon the water. And not only must the materials be dry, but also, when arsenic is used in areas covered with dense grass or other vertical growths, the vegetation itself must be dry, or else the greater part of the powder will adhere to the moist surfaces of the leaves and stalks with the result that but little of it will reach the surface of the water. Under these circumstances, during the long tropical rainy season of the Isthmus, the times favorable for the application of Paris green would be few and far between. The use of oil is dependent on none of these factors and it can be applied at any time regardless of the weather. Moreover, Paris green is said to be mainly effective against the surface-breeding *Anopheles* only, and not so much so against other *Culicinæ* which, in the Canal Zone, it is desired to control as a measure of comfort; nor does it affect eggs or pupæ as does the oil. Furthermore, the presence of an oil film is believed to deter the adult female from depositing its eggs upon water for some time after the oil is applied.

"As described in our annual reports for the years 1921 and 1922, the health department of the Panama Canal sprays hot oil upon the water of the shore line of the Pedro Miguel lakes, using a hand pump drawing oil from a 150-gallon tank mounted in a rowboat. This spraying, when done at 10-day intervals, is practically 100 per cent effective against all *Culicinae*, even the genus *Mansonia* (genus *Taeniorhynchus* of some authors) being apparently deterred by the oil from breeding among the floating *Pistia* which abounds in parts of the lake.

"Paris green costs here 23 cents a pound in 14-pound containers. Fuel oil, as used for mosquito control on the Isthmus, is brought here in tankers from the oil fields of North or South America for use in the floating equipment and other power units of the canal as well as for resale to steamships. From the tankers the oil is pumped ashore into large steel or concrete reservoirs from which it is distributed to points along the canal by pumping through pipe lines, these lines being connected by short laterals to the small health department supply tanks located conveniently to the points of application. Delivered at the water's edge, ready to be drawn by gravity into the rowboat spray tank, the cost of the oil at the present time is $1.35 per barrel of 42 gallons, or less than 3¼ cents a gallon. Three men are required for its application; one to row or pole the boat along, one to work the pump, and one to handle the long pipe ending in a spray nozzle. The hot oil can be sprayed on the shore line as fast as the boat can be propelled and surface filming is positive and complete. Wind action and wavelets carry the oil into every

nook and cranny, even to a considerable distance from the point of application. Fairly dense grass and other vegetation does not offer a serious bar to success. Inspection follows every oiling to determine if it has been done thoroughly, and if it is effective in destroying the larvæ. The results apparently could not be cheapened or improved by any other method that is as efficacious.

"Elsewhere than in the lake areas, mosquito breeding is controlled chiefly by training of streams and by draining and filling. Some oiling is of course done in the open streams and ditches, especially in the dry season or at times of slight precipitation. For such oiling, particularly in those ditches that have the precast half-round concrete sectional bottom, the oil soaked mop or drag (described and illustrated in our annual report for the year 1922) is still preferred. This mop cleans and oils at the same time, and so roils the oil with the water, algæ, débris, and whatever larvæ may be present, as to insure its thorough larvicidal action. What were formerly known as 'oiling gangs' are now better described as 'maintenance gangs,' the use of oil becoming less and less each year. Such gangs now carry spades, shovels, and rakes, as well as oil, and are instructed to eliminate by drainage or filling, whenever possible, every bit of water that may prove a potential breeding place within a controlled area.

"The results of our methods of control, and of the more recent extension of sanitation to greater distances from protected communities than was formerly the case, are shown in other ways than by the malaria rates alone. Frequent observations are made both at nightfall and at dawn, with a view to determining what mosquitoes are on the wing. Whereas in earlier years such efforts usually resulted in catching many of the malaria-carrying species within the town sites, for the past 2 or 3 seasons such mosquitoes are only rarely so caught, and places where formerly they might always be found are now practically free from them. Of course this has not been a sudden occurrence, following any particular year's work, but is the cumulative result of many years of progressive efforts. In fact, were it not for the presence on the Isthmus of two harmless, though very annoying species of mosquitoes, the public would hardly realize now that a mosquito problem exists. These two mosquitoes are *Aedes taeniorhynchus*, the banded salt-marsh mosquito, and the *Mansonia tittilans*, a mosquito of very similar appearance on casual examination but of very different breeding habits. Both are voracious biters and both fly very long distances from their breeding places.

"*Aedes taeniorhynchus* apparently finds plenty of breeding places along both coasts of the Isthmus. Beginning at the ruins of Old Panama on the Pacific side and extending 30 miles or more to the

east, brackish tidal swamps form a continuous band from 1 to 2 miles wide along the coast. West of the canal on the Pacific side are several square miles of such swamps within 5 miles of the terminal cities. On the Atlantic side are unmeasured miles of brackish swamp land within the reputed flight distance of *taeniorhynchus*, which is believed to be as much as 40 miles. Yet it must be confessed that fairly exhaustive search in these swamps has discovered no breeding places of these pests sufficient to account for their prevalence at certain seasons of the year. Hydraulic fills, composed of spoil pumped from the canal or the sea, dry and crack during subsequent dry seasons and present most favorable breeding places for *Aedes taeniorhynchus* when the early rains of May and June fill the myriads of deep fissures with brackish water. A hydraulic fill in such condition may furnish a near-by community with vast hordes of these most irritating mosquitoes. Fortunately, control of the fills is made fairly simple by the cooperation of the dredging division. This division in recent years has been most painstaking in placing the dredged material at a proper grade and in furnishing sufficient outlets for the surface water to pass through the dikes. Each year, near the end of the dry season, the fills are inspected by the health department and, if found so extensively cracked as to furnish favorable places for the breeding of *Aedes taeniorhynchus*, the dredging division pumps onto the surface enough water and mud to fill the crevices. This procedure, together with some superficial ditching, usually proves sufficient to take care of the situation until another dry season. If no more mud is pumped on than is needed to fill the cracks, the surface does not fissure so badly, if at all, during the succeeding dry season; but if a thick layer of new mud is added, the fissured condition repeats itself in the following period of drying. If no mud is pumped onto the broken surface of the fill, the fissures persist at lessening depths for several years (especially in oozy material lacking sand), but they finally become obliterated by scouring action of the rains, and then the control problem becomes one of less difficulty.

"The genus *Mansonia*, of which the species *titillans* is the most common, has enormous breeding areas in the water lettuce (*Pistia*) and floating sedge-grass islands of the more remote parts of Gatun Lake. In the quiet inlets of Miraflores Lake the breeding of *M. titillans* in the roots of *Pistia* is apparently controlled by the oiling that is done there at 10-day intervals; at least, frequent search does not discover the larvæ among the *Pistia* so treated. The surface film of oil must interfere with the breeding cycle at some stage, but whether with the laying of the eggs, with the eggs themselves, or with the developing larvæ we do not know. *Titillans* is frequently encountered in the cities, far from any possible breeding place, and

at times nearly equals the ubiquitous *Aedes taeniorhynchus* in numbers. *Mansonia* is present throughout most of the year, except that the dry-season winds reduce its prevalence, but *Aedes taeniorhynchus* is generally a nuisance only during the early weeks of the rainy season."

## A CASE OF SMALLPOX AT THE UNITED STATES NAVAL TRAINING STATION, SAN DIEGO, CALIF.

By John B. Kaufman, Captain, Medical Corps, United States Navy

A seaman, second class, with a temperature of 101° F. and with vague abdominal symptoms reported at the main dispensary, United States Training Station, San Diego, Calif., during sick call on the morning of February 15, 1928, for treatment. A physical examination by a medical officer at that time failed to disclose symptoms or signs other than those suggestive of constipation. He was accordingly admitted for observation and given a low enema, which was followed by excellent results. The next morning his temperature was normal and, as he appeared and felt well, he was restored to duty.

On the morning of February 20, or five days later, he again reported at morning sick call presenting mild constitutional symptoms and a rash which was considered typical of smallpox. The distribution of the rash was general and consisted of scattered discrete lesions. According to the patient's accepted statement all the lesions had appeared simultaneously. It was found upon questioning that he had pains in the back of the neck but none in the dorsal or lumbar region. He was vague in his answers regarding nausea but stated definitely that he had not vomited. A diagnosis of smallpox was made and the patient was immediately placed in the isolation tent. He was transferred to the city quarantine hospital, San Diego, Calif., within three hours after admission.

The patient was received at the station as a recruit from Omaha, Nebr., on October 3, 1927. His health record indicated that he had been vaccinated against smallpox on October 3, 1927, and the result recorded as a failure. He was revaccinated on October 14, 1927. After the second vaccination a red areola appeared about the site of the inoculation and later a small scab formed. This was interpreted as a primary reaction and an entry made to that effect in his health record by the medical officer.

Further questioning revealed the fact, supported by the station records, that the patient had been granted leave to take effect on January 20, 1928, and that he had returned to the station on February 12, 1928, or before his leave had expired. He also stated that

while returning to San Diego by train from his home in Atlantic, Iowa, a woman passenger occupying a near-by seat in the same coach in which he was riding was removed from the train at Kansas City, Mo., and transferred to a local hospital. She was "broken out" at the time and the patient was told later that she had smallpox. This occurrence was elicited after he was admitted with smallpox as he failed to report the incident upon his return to the training station from leave.

Information was obtained from three associates who worked with him in the personnel office to the effect that the patient in explaining his early return from leave stated he had found it necessary to return before his leave was up to avoid quarantine, as a brother had developed smallpox. He also stated that the physician in his home town had "fumigated," not vaccinated, him so he could return.

Acting upon this information, a letter was addressed to the health officer, Atlantic, Iowa, requesting information. A reply was received from the local physician in attendance stating that the youngest brother had developed smallpox on February 1, but that the patient had not been sufficiently near his brother at any time to have been effectively exposed and had left the house the same day.

While it can not be definitely stated that a case of smallpox did not occur in the same coach of the train in which the patient was returning, the probability is that he contracted the disease from his brother while at home on leave. The date of the onset of symptoms and the period of incubation would seem to substantiate this view. There was no evidence upon his return to the station to show that he had been recently vaccinated.

Upon further investigation it was found that the patient had been assigned billets in two different tents after his return from leave and that he was in contact with many of his shipmates in going to and from his tent. He was in close contact constantly during working hours with his associates in the personnel office and had mingled at mess, moving-picture entertainments, on liberty, and otherwise, with a large number of the personnel. As it was probable that the eruption was present for at least one day prior to his reporting for treatment at the dispensary, the possibility of other cases developing was sufficient to cause considerable apprehension.

Recommendations were made to the commanding officer, therefore, as soon as the diagnosis of smallpox was definitely decided upon, that the entire naval and civilian personnel of the station be vaccinated. This recommendation was immediately approved and an emergency requisition for vaccine virus was sent by telegram to the Naval Medical Supply Depot, Mare Island, Calif. In the mean-

time all the available vaccine virus was secured from naval activities in the vicinity.

On February 20, the day on which the case of smallpox was admitted, vaccination of all the personnel of the station was started. This was continued until all persons were believed to have been protected.

The total number vaccinated, together with the results observed, are given in the following table:

| Total number | Vaccinations | Primary reactions | Immunity reactions | Failures | Previous scar | No scar | History of smallpox |
|---|---|---|---|---|---|---|---|
| First inoculation | 2,003 | 472 | 1,064 | 467 | 1,856 | 87 | 67 |
| Second inoculation | 295 | 61 | 90 | [1] 144 | | | |
| Third inoculation | 45 | 4 | 9 | 32 | | | |
| Fourth inoculation | 11 | 0 | 0 | 11 | | | |

[1] Includes those with a history of smallpox.

It will be noted that 67 men gave a history of smallpox. An examination of their health records, however, showed that such an entry had been made in but a few instances. It is possible that some of these men wished to avoid vaccination by this practice, as a number of them developed primary reactions. Consequently those men who stated that they had had smallpox were instructed to obtain letters from the proper authorities at the places where they were treated for this disease. When this data is received appropriate entries will be made in the records of the men concerned.

For the protection of the local communities, general liberty for the personnel was stopped immediately after the case of smallpox was detected and permission to leave the station granted only to those men who were at once revaccinated and, in addition, presented good scars. Later, liberty was extended to include those in whom primary, immediate, or immune reactions could be demonstrated or to those having health records in which a definite history of smallpox was noted.

All persons who were known to have been in close association with the patient since his return from leave were carefully watched. This group included 21 men in the personnel office, certain tentmates in the two tents that he had occupied on separate occasions, and all men who had been in the sick bay when he was admitted and treated for constipation. These men were inspected twice daily and no liberty granted except for those who were believed to be immune. Those without scars and who gave negative reactions upon revaccination were isolated in one of the cubicles at the rear of the dispensary until the full period of incubation had passed. Up to March 15, no other cases of smallpox have developed.

The contrast in the results obtained with the vaccines used in immunizing the personnel was notable. In approximately the first 800 vaccinations the virus employed consisted of that on hand at the station and that borrowed from the marine base and the naval hospital. This vaccine was received on January 20, 1928, and used before the date of expiration marked on the packages. It is the practice at the station to keep cowpox virus continuously in the ice box and it is presumed that the borrowed vaccine was preserved under similar conditions.

When about an equal number of persons had been vaccinated with fresh vaccine, received in response to our telegraphic request from laboratories near San Francisco, Calif., the greater percentage of positive and immune reactions observed became the subject of considerable comment. It would appear that the potency of vaccine virus is greatly reduced even after one month's continuous storage at ice-box temperatures. A frequent supply of small quantities of fresh virus from the nearest available laboratory should therefore be productive of a larger percentage of positive reactions and a higher degree of immunity among those vaccinated.

*Comment.*—There is no data at hand to indicate the severity of the attack of smallpox experienced by the patient's brother, but it possibly was of the same mild type as that which occurred at the naval training station, San Diego, Calif. There is also the possibility that sufficient immunity resulted from the vaccination received at the training station to protect him from a more severe attack. As Leake points out, practically perfect protection can be given in the case of an individual capable of responding, by the mildest sort of vaccination, if repeated frequently enough. An occasional case of smallpox may occur in spite of recent vaccination but the disease will not spread if all members of a population group have been properly immunized.

The conclusion reached by Leake, of the United States Public Health Service, is that recent successful vaccinations with a *potent* virus is a certain protection in case of subsequent exposure to smallpox in nearly every instance. The expression, successful vaccination in this sense includes the reaction of immunity, all forms of accelerated reactions, and the primary take.

Vaccine virus when it leaves the manufacturer is presumably potent. At ordinary room temperature it probably will not retain its potency for more than 7 days. When kept at the usual ice-box temperature of 40° F. it has been found to be potent for about three months. When kept at a temperature below 32° F. it will remain fully potent for at least a year. In fact, some samples of vaccine that have been kept continuously at temperatures consider-

 

ably below 32° F. have been found fully potent after nearly three years' storage.

All of the largest and many of the smaller types of naval vessels have an ice machine of some type or other and refrigeration spaces that are habitually kept at a temperature of 32° F. or below. It is therefore recommended that medical officers store vaccine virus continuously in the cold-storage space of the ship or station from the time it is received until used. When this is not practical it should be placed in a water-tight container and kept continuously in the ice chamber of a refrigerator, preferably surrounded by ice. Merely placing it in a refrigerator is not sufficient.

The following criterion of potency is suggested by John F. Force, special expert, and James P. Leake, surgeon, United States Public Health Service. A smallpox vaccine of high potency, when diluted 1:1,000, should produce a confluent eruption on from 90 to 100 per cent of the vaccinated area on the back of a rabbit, and when diluted 1:3,000 the decrease in confluence should not be over 20 per cent. A vaccine satisfying this criterion should produce, in all previously unvaccinated human subjects, a circular vesicle measuring at least 7 millimeters in diameter on the seventh day when applied, undiluted, to a circle of the exposed derma measuring 2 millimeters in diameter.

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## EXPLODING SOME NARCOTIC THEORIES

The following article by Dr. Carleton Simon, entitled "Exploding some narcotic theories," is reprinted from the Police Journal for November, 1927:

"The use of drugs, whether grown out of the earth or the product of the laboratory, which have among their various properties the power to enslave the soul, the mind, and the body, is a subject worthy of special study. It is particularly of far-reaching importance when such substances not only deleteriously influence human behavior but also in their spread become a danger to humanity and to civilization.

"In the United States the shackles of this modern curse have held many hundreds of thousands of beings in bondage. Of this large number many have valiantly found their way back toward freedom and thousands are still held in slavery that dominates every waking and sleeping moment.

"The contributing causes for such addiction are very numerous, the chief avenue being through the underworld, which is composed so largely of poorly mentally equipped or physically defective types. Every angle of the narcotic menace is a problem that can not be dispelled lightly with a ready solution or met with any general remedy.

Although society protects itself as much as possible with the enactment and the enforcement of various laws that aim to limit the use, the sale, and the production of narcotics, these are being constantly circumvented, because the great urge that demands relief must be satisfied at any cost. No addict fears the law, especially when his habit consumes him with irresistible and unceasing demands. He must obtain his drug at any cost.

"The great broad division into which we can divide the narcotic problem is the demand and the supply. If there was no demand there would be no supply. If we curtail the demand the supply would automatically shrink.

"The first important step in the solution of this problem is to charitably help the suffering addict, to cure him of his addiction. Drug addicts, however, hate to face the firing line of a cure because of their deep-rooted aversion to pain. Again, others have assumed that their addiction is incurable because the greater number of addicts have tried various so-called cures and gone back again to their dope. In fact, the large number of our drug addicts to-day are recidivists or those that have been partially off their drug and gone back again. This backsliding is largely due to the faulty methods employed in most of our public institutions. It is very easy to take a drug addict off his dope without inflicting suffering upon him but the real problem is to keep him off of it. Many of our institutions send out men and women after a few weeks' treatment and it is no wonder that they go back. Everyone knows that after a serious operation or a grave illness it takes months of convalescence to bring back a patient to full health and this same theory or fact should be applied to the treatment of addicts. To remove the memory association of the habit and to establish a general physical balance requires a great length of time. Because of this incontrovertible knowledge we have always contended that the great truth about any permanent cure of the addict and his redemption consisted not so much in taking him off his narcotic but in rehabilitation of his spiritual self, in the gradual recovery of his mental viewpoint, and in the proper readjustment of his various bodily functions. This all takes long periods of time and any cure that promises to perform miracles, such as an immediate cure for a habit that has become deeply grooved throughout almost all of the various organs, such a promise is utterly false and futile. Because of this we have always taken the attitude that every State should have addict colonies where proper convalescence is possible. To continue to send addicts away several times a year is a highly expensive and foolish procedure and as soon as this is recognized by our various municipalities and a saner policy adopted then only will we be able to accomplish something definite and lasting. Short

cures are absolutely of no value. In the establishment of colonies suitable vocational training may be secured. This is important as it occupies the mind and an honest trade can be taught to many. This holds true particularly of the underworld addicts who have not had a right start in life and have been living upon their wits, seeking pleasure and self-indulgence.

"A great deal of hysteria, misinformation, misstatements, and gross exaggeration has done harm in the proper presentation of logical solutions of the very many angles of the narcotic problem. Startling and wholly unsupportable statements have been made in reference to this subject with indifference and disregard of the truth merely to support propaganda in which certain individuals were engaged or financially interested.

"Again, because of insufficient or inaccurate knowledge many laws have been framed and enacted which have at various times embarrassed and annoyed physicians, dentists, and pharmacists engaged in alleviating human suffering. This has been due to the wide belief that the large amount of addiction was due to the physician in the giving of narcotics and in preparations sold by pharmacists. As a matter of fact, the records of the New York police department shows that in approximately some 15,000 arrests during a period of six years only 2 per cent could credit their addiction to medical reasons.

"Similar dishonest or untrue statements have been spread broadcast throughout the country that many school children were drug addicts. People have been told that the narcotics were offered in candy and that street traffickers lay in wait for the children as they came out of school. This is all pure 'bunk' for propaganda purposes.

"In the records of over 23 nations, 300 cities of the United States, and in the records of the department of education of the city of New York there is not a single instance on file where a school child was an addict, in spite of the fact that there are registered in the educational department of this city about a million school children of all grades. Many cases quoted as being school children addicts were investigated, and in no instance was there found a single authentic case. This entire country has been combed over, as it were, in order to locate a single genuine case, and every report has been investigated. School-children addicts are a myth, and parents need have no fear. School children have no money to make them targets for the narcotic trafficker, for it must be remembered that to satisfy the daily dosage of an addict means an average of at least $2 daily. Upon the other hand, our school system has reached such an advanced state with efficient and conscientious supervision that such addiction would be immediately discovered.

"An evil such as this can not be combatted by untruths, for it besets this problem with additional burdens and sidetracks the best efforts of those familiar with it.

"Innumerable and individual problems can be solved. All addicts are not criminals, yet many criminals are addicts. Because of this phase the subject of addiction is of particular interest to police departments. In a short talk such as this the mere surface of this entire question can only be touched.

"I can not let this opportunity pass without also challenging the statement so frequently heard that there were millions—yes; one recent statement read 4,000,000—addicts in the United States, when definite and authoritative figures show that we have in fact about 200,000. This lesser number is a sufficiently large army and is in general composed of old addicts, for statistics of arrests prove that there are few beginners or new recruits and that those arrested show an ever-increasing age peak. The greater number of those arrested are about 30 years of age, whereas formerly this general age was lower.

"The problem that continually faces police departments, and, I might add, the crux of the entire situation, lies in the fact that almost every addict coming under their official notice has been a number of times apprehended by them. It is simply a continued repetition. The records of police identification bureaus prove this very significant truth. Because of this fact brought home so frequently and apparently lost sight of by those who have the solution of this problem at heart, it becomes imperative that the greatest lasting and most certain benefits will result in a policy that will take the addicts off of our streets and place them into institutions for a sufficient length of time to insure a permanent cure.

"This can not be stressed too much, for it is the chronic and so-called confirmed addict that are the customers of the street narcotic trafficker. These old users know the ropes and are in turn known to those rats of the underworld who sell dope.

"If we but accept this knowledge and proceed from this basis that the large number of our present addicts have had from 1 to 30 so-called cures and are back-sliders, or to put it possibly more charitably, have never been cured, a new attitude toward this subject would be created. With this presentation fixed, it obviously becomes clearer why the peak has advanced. The arrest sheets of every police department, though giving in some instances a large number of arrests, nevertheless, when simmered down, show that the addicts arrested are not as numerous as arrest figures might tend to prove, but that this number is composed largely in duplication in the arrests of the same individuals.

"According to certain legal decisions, the Federal law-enforcing agencies have no jurisdiction over the addict, their chief aim being the apprehension of the drug smuggler and the control of the sources of supply. The care of the addict therefore becomes a State duty, a problem that must be sympathetically but firmly solved in the interest of the addict and of the public."

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## AN OUTBREAK OF FOOD POISONING ON BOARD THE U. S. S. "COLORADO" ATTRIBUTED TO HASH. NOT INVESTIGATED

An outbreak of food poisoning of mild type occurred on board the U. S. S. *Colorado* on the morning of June 28, 1927, following breakfast, at which beef hash on French toast had been served. The ship left New York, N. Y., on June 16, 1927, passed through the Panama Canal on June 23, 1927, and at the time of the outbreak was in the Pacific Ocean under tropical conditions en route to San Pedro, Calif.

About 150 persons, or approximately 10 per cent of the crew, were affected, all of whom ate in the general mess and gave a history of having eaten beef hash for breakfast. The same food had been served to the entire crew, but no others developed symptoms of food poisoning.

The first indication of illness among the crew occurred about 10.30 a. m., or about three and one-half hours after breakfast, when patients with abdominal symptoms reported at the sick bay for treatment. All patients were affected at about the same time. They were seen by the medical officer soon after the onset of symptoms, which was sudden and accompanied by cramps in the abdomen.

In nearly all cases nausea and vomiting occurred, lasting over a period of from two to three hours. In most cases a mild diarrhea followed in about five hours. The stools were loose and serous in character, containing small amounts of mucus but no blood. Most patients had severe colicky pains for several hours, but no abdominal distention was noted. Chilly sensations were experienced by practically all of the patients at the onset of symptoms. Temperatures varying from normal to 100° F. lasted from five to six hours and then returned to normal.

Upon physical examination the patients appeared pale with face bathed in cold perspiration. This pallor, however, alternated with flushing of the face. No eruption was noted in any case; the skin in general was cold and clammy. There were no disturbances of reflexes. The pulse, as a rule, was rapid while symptoms persisted. The blood pressure was not taken. Respiration was normal and examination of the chest negative. Most of the patients had increased salivary secretion, but no bitter taste was noticed.

In general, there was slight prostration, sudden in its onset, but it was not a prominent symptom in any case. Many of the patients had mild frontal headache. None had muscular soreness or cramps.

No white blood counts or blood cultures were made, nor were bacteriological examinations made of the vomitus or stools. It was reported that small amounts of the suspected hash were inspected, but there was no conclusive evidence, as might be expected, from such a casual examination, that the meat was unfit for human consumption. The symptoms were mild, and, following eliminative treatment, all patients returned to duty the next morning.

The menus served on June 26 and 27 and for breakfast on the 28th of June were as follows:

*Sunday, June 26, 1927*

| BREAKFAST | DINNER | SUPPER |
|---|---|---|
| Fresh fruit. | Cream potato soup. | Cold sliced meats. |
| Boiled rice. | Roast loin of pork. | Sliced cheese. |
| Milk and sugar. | Brown gravy, dressing. | Potato salad. |
| Fried luncheon meat. | Mashed potatoes. | French dressing. |
| Pan gravy. | Asparagus cream sauce. | Plain boiled beans. |
| Cottage fried potatoes. | Apricot pie. | Sweet sliced pickle. |
| Bread, butter, and coffee. | Crackers. | Fresh fruit. |
| | Bread and coffee. | Applesauce. |
| | | Bread and cocoa. |

*Monday, June 27, 1927*

| BREAKFAST | DINNER | SUPPER |
|---|---|---|
| Tinned prunes. | Rice tomato soup. | *Baked railroad hash.* |
| Rolled oats. | *Pot roast beef.* | Stewed tomatoes. |
| Milk and sugar. | Brown gravy. | Baked macaroni and cheese. |
| Fried plain omelette. | Boiled peeled potatoes. | Fresh fruit. |
| Fried SC bacon. | Boiled string beans. | Bread, butter, and tea. |
| Hash brown potatoes. | Baked bread custard pudding, vanilla sauce. | |
| Bread, butter, and coffee. | Bread and coffee. | |

*Tuesday, June 28, 1927*

BREAKFAST.—Fresh fruit; *fresh fried meat hash;* tomato sauce (catsup); French toast; table sirup; bread, butter, and coffee.

Inspection of the galley revealed nothing unusual. Physical examination and questioning of the commissary steward, cooks, and others engaged in the handling, cooking, and serving of food, indicated that they were in good health. No history of recent intestinal disorder was elicited.

As the symptoms appeared from three to four hours after breakfast and as all those affected had eaten hash at this meal, beef used in making the hash was thought to be the causative factor. The beef was purchased on Navy contract in New York City, was inspected at

the time of delivery on board, and was apparently in excellent condition. It was immediately placed in the ship's cold storage where it was kept at a temperature of about 25° F. The meat, which was found to be frozen solid at the time, was removed from the cold storage during the afternoon of June 26 and suspended from hooks in the butcher shop to thaw out.

It was first cooked on the morning of June 27 and was apparently in excellent condition when served in the form of pot roast at the noon meal. Some of the same meat was used to make "railroad hash" for the evening meal. The left-over meat from these two meals was made into a hash which was placed in cold storage from the evening of June 27 until 3 o'clock on the following morning when it was removed, cooked, and served to the crew on French toast for breakfast. In preparing the hash the meat was handled by the cooks and messmen none of whom showed symptoms of intestinal disorder.

It was believed that the meat probably became infected during the handling incident to the preparation of the hash and that incubation occurred during the period of several hours that it was exposed to a relatively high temperature in the galley before being returned to cold storage. The ship at this time was off the west coast of southern Mexico where the air was very hot and sultry.

The sudden onset and rapid disappearance of symptoms suggest that a preformed, heat-resisting toxin was responsible and that actual infection did not take place. It also appears that the hash was exposed for several hours to a temperature favorable for bacterial growth. A number of bacilli of the meat-poisoning group, especially those resembling the *Bacillus of Gartner* are known to contain an endotoxin resistant to heat. It is therefore possible that sufficient endotoxin was present to produce symptoms in these cases, and that the infecting microorganisms were killed during the cooking.

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## SMALL OUTBREAK OF FOOD POISONING AT THE UNITED STATES NAVAL STATION, OLONGAPO, P. I., ATTRIBUTED TO CANNED VIENNA SAUSAGE

A small outbreak of food poisoning presumably resulting from contamination of canned Vienna sausage with bacilli of the meat-poisoning group occurred on May 27, 1927, among members of a marine expeditionary force stationed temporarily at Olongapo, P. I.

About two hours after the noon meal patients began to report at the dispensary with gastrointestinal symptoms. Other patients arrived during the afternoon and evening until midnight when the last patient reported. Of a total strength of 1,468 men but 49 were affected.

The symptoms developed from about 2 to 12 hours after eating the suspected food and consisted of nausea, vomiting, severe abdominal cramps, and diarrhea. None of the patients were sufficiently ill to require admission to the sick list and all of them were ready for duty the following morning. The treatment given consisted of 60 c. c. of castor oil followed by 4 c. c. of paregoric.

The menu of the noon meal served on May 27 was as follows:

| | |
|---|---|
| Vienna sausages, canned. | Potatoes. |
| Canned corn. | Pudding. |
| Canned sauerkraut. | Bread and butter. |
| Canned string beans. | |

An investigation, started immediately upon the appearance of a sufficient number of patients to suspect an outbreak of food poisoning, revealed the fact that all those who became ill had eaten Vienna sausages during the noon meal. Most of the patients also stated that in their opinion the sausages had a peculiar taste.

Samples of the food could not be secured for examination, but samples of the stools were obtained from several of the patients and sent to the laboratory of the United States Naval Hospital, Canacao, P. I., for culture purposes.

A copy of the sanitary regulations placed in effect immediately after the outbreak is as follows:

1. The following sanitary regulations are published for the information and guidance of this command.

2. Commanding officers of all grades are responsible for the policing and sanitary condition of the area and boundaries of areas occupied by their commands.

3. All matters pertaining to sanitation shall be referred to the regimental surgeon and his recommendation upon approval by the regimental commander shall be carried out.

4. Mess Hall.—(*a*) The mess officer will be held responsible for the cleanliness of the galley and mess hall and the grounds surrounding the same.

(*b*) *Personnel.*—Cooks and messmen shall be required to report to the dispensary on the 1st and 15th day of each month for inspection. They shall be required to bathe at least once daily, to thoroughly wash their hands frequently, and especially before handling food, and to keep their finger nails clean and trimmed.

5. Food.—(*a*) The utmost care shall be exercised in the handling of foods whether fresh or canned. All food not served fresh shall be *thoroughly* cooked.

(*b*) Fresh vegetables and fruits shall be dipped in boiling water for a period of at least 10 seconds before being served.

(*c*) Cleavers, hatchets, or other instruments used for opening cans shall be washed and dipped in boiling water before being used for this purpose.

(*d*) Cans which are "BLOWN" or are at all suspicious shall be discarded.

(*e*) Fresh fish and other sea food shall be kept on ice until just before cooking. Under no circumstances shall foods of this description be kept over 24 hours before cooking.

6. Disposal of Garbage.—(*a*) All garbage shall be placed in containers provided therefor. Containers shall be kept covered at all times and after the contents have been collected they shall be thoroughly washed out with hot water. Care shall be exercised that soiling of the ground surrounding garbage containers does not occur, this favors fly breeding.

7. Toilets.—(*a*) All toilets shall be policed twice daily. Seats shall be scrubbed once daily with soap and water.

8. Bathing.—(*a*) All men shall be required to bathe at least once daily. Attention is invited to the desirability of thorough drying, especially between toes, after bathing. Failure to observe this precaution will result in sore feet.

9. Care of the Feet.—(*a*) The importance of well-fitting shoes and socks can not be overemphasized. In addition to the instructions contained in the memorandum of May 27, 1927, it is directed that on the completion of practice marches, company commanders hold a foot inspection, require all men to bathe their feet and put on dry socks and shoes.

10. Mosquito Nets.—(*a*) Due to prevalence of mosquito-borne diseases in Olongapo and vicinity all men shall be required to sleep under nets at all times.

11. Water.—(*a*) All water at Olongapo and Maquinaya is fit for consumption.

A report received later from the laboratory stated that a motile gram negative bacillus that did not ferment lactose was isolated from the samples submitted. It was identified as the *Bacillus enteritidis*.

## TWO EMERGENCY AIRPLANE AMBULANCE TRIPS TO CAPE HATTERAS, N. C.

By Dean H. Vance, Lieutenant Commander, Medical Corps, United States Navy

An ambulance airplane trip was made from the United States Naval Air Station, Naval Operating Base, Hampton Roads, Va. to Coast Guard Station No. 182, an isolated post located near Cape Hatteras, N. C., on Sunday, December 18, 1927, for an emergency surgical case in response to a call for assistance from the Naval Radio Station at the cape.

The station F5–L plane was used, as is usually the case, manned by a crew consisting of two pilots, a mechanic, a bow man, and the writer. Due to a late start, the latter part of the return flight was made after dark.

The plane was forced to land in the waters of Chesapeake Bay near Thimble Shoals light because of motor trouble and the remainder of the trip to the air station was accomplished through the slow process of "taxiing" with the power furnished by one motor, while the mechanic and bowman "dollied" ship by walking the wings to keep a straight course.

This process took about two hours and the patient, who had an attack of acute appendicitis complicated with a six months' pregnancy, was taken to a local hospital, arriving there in comparatively good condition. She was delivered of the fetus and later operated upon for the removal of the diseased appendix.

The writer can not express too highly the admiration he possesses for the consummate skill displayed by Chief Aviation Pilots Byrne and June in making a successful landing with one motor on a rough sea in the dark, and the subsequent voyage to the station without damage to the plane or personnel.

Another ambulance airplane trip was made to Cape Hatteras on March 21, 1928, with the station F5–L plane for a patient who was in a very dangerous condition due to a terminating pregnancy and the lack of proper care. In this case the weather conditions were good and the trip was uneventful. The patient was removed, upon arrival at the air station, to a local hospital where she arrived in good condition and was delivered of twins the following day.

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### BLISTER BEETLES OF THE GENUS PAEDERUS (COLEOPTERA: STAPHYLANIDAE) PRESENT ON THE ISTHMUS OF PANAMA

The following paragraphs were abstracted from the report of the health department of the Panama Canal for the calendar year 1926, as having an application to naval personnel on duty in the vicinity of the Canal Zone:

"During the month of March, 1926, there was received here for identification a number of insects from Ecuador, accompanied by a memorandum stating that, following a period of unusual rainfall in that country, these insects had occasionally appeared there in large numbers, and that, coincidentally with their presence in a community, and only then, there would appear a violent epidemic of dermatitis, sometimes so severe as to resemble erysipelas. These insects were identified as rove-beetles (*Coleoptera: Staphylinidae*) and specimens were forwarded to the United States National Museum at Washington for further identification. They proved to be a new addition to this already numerous family and were named *Paederus irritans* by Doctor Chapin. The disease they cause, known as *seasonal bullous dermatitis*, and the insects that cause it, have been described in European textbooks [1] of tropical diseases, although they seem to have been overlooked by American writers.

"Since receiving the South American specimens, a similar insect, *Paederus columbinus* de Laporte, also known as the cause of outbreaks similar to the recent ones in Ecuador, has been discovered in the Canal Zone. Little is known of its breeding habits, and no more than a few specimens of it have been taken here, nor has the characteristic dermatitis been recognized here, yet the presence and performance of these insects must be borne in mind as a possible source of such an outbreak in the Canal Zone in the future."

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[1] Castellani and Chalmers: Manual of Tropical Medicine, third edition, 1919, p. 2204, and in The Practice of Medicine in the Tropics (edited by Byam and Archibald), Vol. III, 1923, p. 2420.

The article by Doctor Chapin (1926) of the Bureau of Animal Industry, United States Department of Agriculture, which was referred to in the above extract and which was published in the "Sonderabdruck aus Archiv fur Schiffs- und Tropenhygiene, 1926, Band 30, S. 369–372, Verlag von Johann Ambrosius Barth, Leipzig," is as follows:

"Since 1912, workers in various parts of the world have identified certain species of beetles belonging to the genus *Paederus* in connection with the occurrence of an acute vesicular dermatitis in man. Da Silva (1912) reported *Paederus columbinus Lap.* as the cause of the disease in Brazil. Goeldi (1913) connected two species with the disease, one *Paederus goeldi Wasm.* from Rio Purus, Upper Amazon, and the other, *P. peregrinus Erichs*, from Java. Rodhain and Houssiau (1915) described a vesicular dermatitis which occurs at Leopoldville, Belgian Congo, and associated with it a beetle which was afterwards determined by Mr. Howard Notman as *Paederus sabaeus Erichs.* This determination was published by Dr. J. Bequaert (1921) in a paper in which he summarized the literature up to that date.

"Sacharov (1915) described a serious outbreak of the disease in South Russia, especially in the delta of the Volga and indicated *Paederus fuscipes Curtis* as the causal agent. This same species has recently been shown to be the cause of 'spiderlick' in India by Strickland (1924). Finally, so far as natural outbreaks of the disease are concerned, *P. Crebripunctatus Epp.* is responsible for it in Nairobi, British East Africa, according to Ross (1916), and *P. amazonicus Sharp* is indicated as the causal organism at Manaos, Amazonas, Brazil, by Gordon (1925).

"Thus seven already described species of this genus and one which is described for the first time in this paper are known to produce a dermatitis under field conditions. In the laboratory, Netolitsky (1911) has used two European species, *Paederus limnophilus Erichs* and *P. gemellus Kraatz*, and has produced a condition similar to that observed by other workers.

"The present epidemic has appeared at the camps of the following concerns: California Standard Oil Co., Chanduay; South American Gulf Oil Co., Santa Elena; International Petroleum Co., Zapotal. These camps are all in the vicinity of Guayaquil, Ecuador, and the specimens described below have come from the second of the three mentioned. The following statement of the disease is taken from the letter of Dr. T. L. Harrison, medical officer to the Anglo-Ecuadorian Oil Fields (Ltd.):

The disease appears suddenly without warning, and a patient wakes in the morning to find a hot painful itching of the nose, alae nasi, malar bone areas and the areas around the eyes. There may be a marked oedematous condition

of the conjuctival sacs, in fact in some of the worst cases the eyes have been partially closed and in others totally closed. The rash may extend to the forehead in a clear dark red background, with here and there a linear mark like a wheal, as if a rough serrated piece of wood had been drawn roughly across the forehead, slightly leaving the corium (sic!) and through the abrasions little beads of viscous or watery serum exude and later form slight crusts. In severe cases it extends to the neck, shoulders, thorax, and abdomen as far as the umbilicus. These areas are not confluent but are isolated by healthy areas and the wheals may be from a quarter of an inch in length to as long as 7 inches. In the vicinity of the nose and on the side of the nose tiny pustules appear, varying in size from the point of a toothpick to a match head and contain a whitish fluid. These pustules may appear anywhere on the body, in the majority of cases they have appeared first on the nose, malar areas, eyes, and forehead.

Sun exposure appears to irritate it, also lacrymation. The disease extends to the legs, thighs, and, in several cases, to the scrotum and surrounding parts.

Fair results have been obtained from local application of calomel powder, bismuth subnitrate, yellow oxide of mercury ointment, and hot or excessively cold boracic fomentations to the eyes when the latter are involved.

"The specimens of the beetle submitted appear to belong to an underscribed species which may be known as

PAEDERUS IRRITANS NO. SPEC.

"Black, elytra bluish, or greenish black, antennae with the three basal and three apical segments pale and the intermediate segments castaneous. Head as broad as long, posterior angles broadly rounded; shining with sparse punctation, the punctures variable in size. Thorax slightly longer than broad, lateral margins obsolete but indicated by a row of punctures, medial longitudinal field of the disc impunctate, lateral fields sparsely set with fine punctures with a few coarser ones intermingled. Elytra together three-fourths as broad as long, coarsely and rather densely punctured, sparsely set with depressed castaneous hairs. Suture beaded. Scutellum alutaceous. Abdominal segments strongly margined, surface alutaceous and moderately densely and finely punctured, each puncture giving rise to a slender brown hair. Legs piceous, tarsi castaneous.

"Male: Terminal abdominal tergite broadly rounded, terminal sternite with a deep narrow U-shaped notch, the side of the notch finely but sharply beaded.

"Female: Terminal abdominal tergite as in male. Terminal sternite tricuspid, the median cusp three times as long as either lateral one, slender acuminate.

"Length: 10 mm.

"Locality: Ancon, Santa Elena, St. Elena Peninsula, Ecuador.

"Collector: G. H. Sargent.

"Type: A male from the above locality, U. S. National Museum No. 29095.

"Paratypes: Five males and 14 females, same data.

"The species appears to be closely related to *Paederus ornaticornis Sharp*, which was described from a single male collected at Guayaquil. *P. ornaticornis Shp.* is characterized as having the head moderately densely punctured and the antennae with only the terminal segment pale instead of the last three segments pale, as in the present species. As the twenty specimens before me differ constantly from *P. ornaticornis Shp.* in these points I consider that the form deserves specific rank."

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## AN EPIDEMIC OF PLAGUE IN ADEN, ARABIA

A report received from the American vice consul in charge of the United States Consulate, Aden, Arabia, states that plague is present in that port in epidemic proportions. The number of cases reported during the epidemic to January 31, 1928, was 77, with 33 deaths. The report is as follows:

"In spite of the strenuous efforts which are being made by the authorities, the epidemic continues unchecked, with a daily increase of four or five new cases. The infected area is, however, restricted to one section of Steamer Point, and although the number of cases reported shows a somewhat disconcerting increase, it may be said that the epidemic is still fairly well restricted from a geographical point of view.

"A certain amount of shipping is being deflected from the port of Aden at the present time, and it is possible that this will increase if the epidemic is not checked. It is now reported that the authorities at Port Sudan intend to detain ships arriving in that port from Aden for a period of five days from the date of sailing from Aden. It is not believed, however, that American shipping will be effected in any way by measures of this kind, as the usual ports of call for American ships, either eastward or westward bound, are at least five days distant from Aden.

"It is possible that if the epidemic continues, the prosperity of the port may be disadvantageously affected, as it is felt that present channels of commerce may be shifted to other Red Sea ports, always keen to rival the commerce of Aden, and that the new channels of commerce may assume a permanent nature."

A copy of the notice of port regulations which are being carried out in connection with the quarantine service follows:

"A certain number of cases of bubonic plague having occurred in the Steamer Point district of Aden, the port is hereby declared an infected port, and certain restrictions will be imposed on passenger and other traffic from the port, in accordance with the rules framed under section 6 of the Indian ports act.

"These will include:

"(*a*) Medical disinfection prior to embarkation of all passengers (cabin or deck) joining the ship at Aden, and of members of the crew who join at Aden.

"(*b*) Disinfection prior to loading of such merchandise as is, in the opinion of the port health officer liable to carry infection.

"(*c*) Disinfection of clothing, bedding, etc. of Asiatic or African members of the crew or of deck passengers joining the ship at Aden, at the discretion of the port health officer.

"Cabin passengers within 24 hours of embarkation should attend at the port health office, European General Hospital, Steamer Point, between the hours of 12 noon to 2 p. m. for medical inspection, and to obtain a pass without which they will not be permitted to embark.

"Deck passengers should attend at the Abkari Pier, between the hours of 9 to 10 a. m. and 4 to 5 p. m. within 12 hours of embarkation for medical inspection and disinfection of effects where necessary.

"Deck passengers having been examined and their effects if necessary disinfected will not be permitted to leave the Abkari Pier except to embark.

"To facilitate the embarkation of passengers and for medical examination of crew, if necessary, all local steamers will be required to anchor or moor east of No. 8 buoy and west of No. 13 buoy.

"New members of ships' crews joining at Aden will be medically inspected and their effects, if necessary, disinfected before embarking, in the same manner as deck passengers.

"Port clearances and A. & B. certificates when required for local steamers will not be granted until the master of the ship produces the bill of health indicating that the necessary requirements have been carried out.

"All ships, passenger and otherwise, will work in quarantine during their stay in port; no passengers will be allowed on shore and no persons, other than those necessary for the working of the ships and certain routine requirements, will be allowed on board except with the special permission of the port health officer."

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## NOTES ON THE CORRECT PREPARATION OF FORM F CARDS

The attention of all medical officers is directed to the following comments regarding the correct preparation of Form F cards:

The length of service of a patient admitted to the sick list is too often reported incorrectly on line 2 of Form F card. When two or more F cards are required to cover a case there is many times a vast difference in the length of service entered on the several cards.

A case in which 10 cards were required from time of original admission to the sick list until final disposition had length of service entered on but one of the 10 cards correctly. In sequence of dates the lengths of service given in months were 97, 1, 1, 97, 76, 76, 129, 51, 53, 103. Correctly given the figures should have been 97, 97, 98, 98, 98, 99, 99, 100, 100, 101.

In case of an officer the length of service on each Form F card should be computed from the time of his appointment to the Naval Academy, or his appointment as an officer, to the date entered on line 7 plus any service he may have had as an enlisted man in the United States Navy or Marine Corps.

For an enlisted man the length of service on each Form F card should be the total of all previous service in the United States Navy and Marine Corps plus the time computed from the date of last enlistment to the date entered in line 7. When a man has had service in both the United States Navy and the Marine Corps the total of both services should be given. Any previous service in the United States Army must not be included.

*Change of diagnosis.*—Form F cards reporting cases taken up from a change of diagnosis must indicate on line 4 by the use of the phrase "Change of diagnosis" that the case is taken up as such.

This is in accordance with the instructions contained in paragraph 3418 (*b*), line 4, Manual of Medical Department, United States Navy, 1927.

These instructions are in many instances not complied with and when this is not done the card is, as a routine matter, coded in the bureau as a new case instead of altering a case previously coded, thereby causing considerable loss of time in tracing and correcting the cards when the final check of the cases is made.

## HEALTH OF THE NAVY

Statistical returns for the first quarter of 1928 gave a low general admission rate, 380 per 1,000, as compared with an expected rate of 632 for the winter months. This decrease in the rate is due to fewer admissions for acute infections of the respiratory system. The admission rate for accidental injuries was 33 per 1,000 per annum during the quarter. This rate is very low compared to the corresponding median rate for the preceding five years, which is 65. An explosion of gasoline on board the U. S. S. *Whitney*, March 21, 1928, resulted in the death of 5 men, and landplane accidents caused the death of 6 officers and 4 men.

An outbreak of acute catarrhal fever appeared at the United States naval training station, Great Lakes, Ill., in December, 1927, when 136 admissions were reported. There were 192 admissions for this disease in January, 112 in February, and 212 in March, making a total of 516 for the first quarter of 1928, as compared with 242 for the last quarter of 1927. Six cases of cerebrospinal fever developed at this station during the quarter, 4 of which terminated fatally. One case of cerebrospinal fever was reported by the United States naval training station, Newport, R. I., in January and 4 in February, or a total of 5 for the quarter.

Contrary to expectancy, the Navy was comparatively free from measles during all three months of the quarter.

One case of smallpox developed at the United States naval training station, San Diego, Calif. The patient was exposed at his home while on leave. No secondary cases were reported by this station.

Two deaths from rabies occurred at the United States legation guard, Peking, China. The men were bitten while administering medicine to a sick dog in October, 1927. One patient died on January 3, 1928, or eight days after symptoms appeared, and the other patient died on January 9, or five days after admission to the sick list.

Reports from forces afloat indicate that morbidity rates for disease and accidents and injuries were much less than expectancy. The admission rate for the quarter was 344 per 1,000 per annum, as compared with the corresponding median rate for the preceding five years, which is 526.

The U. S. S. *Colorado*, U. S. S. *New York*, and the U. S. S. *Somers*, of the Battle Fleet, and the U. S. S. *Wyoming*, of the Scouting Fleet, each reported one case of cerebrospinal fever. The patients from the U. S. S. *Colorado* and U. S. S. *Somers* died at the United States naval hospital, Puget Sound, Wash.

An outbreak of food poisoning attributed to contaminated meat occurred among the men of the Twelfth Regiment, Third Brigade, United States Marines, at Tientsin, China. Twenty-four persons were affected. Another outbreak of food poisoning occurred on board the U. S. S. *Trenton* and U. S. S. *Milwaukee* at Guantanamo Bay, Cuba, on February 22, 1928. Contaminated chicken salad, which had a "peculiar taste," served at a smoker on board the U. S. S. *Milwaukee*, at which men from the U. S. S. *Trenton* were present, was suspected as being the causative agent. Forty-four members of the crew of the U. S. S. *Trenton* and 38 of the U. S. S. *Milwaukee* were affected. The symptoms in most of the cases were mild. There were no fatalities.

TABLE No. 1.—*Summary of morbidity in the United States Navy and Marine Corps for the quarter ended March 31, 1928*

| | Forces afloat | Forces ashore | Marine Corps | Entire Navy |
|---|---|---|---|---|
| Average strength | 75,703 | 38,988 | 19,395 | 114,691 |
| **All causes:** | | | | |
| Number of admissions | 6,514 | 4,376 | 1,682 | 10,890 |
| Annual rate per 1,000 | 344.19 | 448.95 | 346.89 | 379.80 |
| **Disease only:** | | | | |
| Number of admissions | 5,855 | 4,084 | 1,569 | 9,939 |
| Annual rate per 1,000 | 309.37 | 419.00 | 323.59 | 346.64 |
| **Communicable diseases, exclusive of venereal disease:** | | | | |
| Number of admissions | 1,886 | 1,885 | 525 | 3,771 |
| Annual rate per 1,000 | 99.65 | 193.39 | 108.28 | 131.52 |
| **Venereal disease:** | | | | |
| Number of admissions | 2,309 | 767 | 569 | 3,076 |
| Annual rate per 1,000 | 122.00 | 78.69 | 117.35 | 107.28 |
| **Injuries:** | | | | |
| Number of admissions | 652 | 292 | 113 | 944 |
| Annual rate per 1,000 | 34.45 | 29.96 | 23.30 | 32.92 |
| **Poisoning:** | | | | |
| Number of admissions | 7 | 0 | 0 | 7 |
| Annual rate per 1,000 | 0.37 | 0 | 0 | 0.24 |

TABLE No. 2.—*Deaths reported, entire Navy, during the quarter ended March 31, 1928*

| | | Navy | | | Marine Corps | | Nurse Corps, nurses | Total |
|---|---|---|---|---|---|---|---|---|
| | | Officers | Midshipmen | Men | Officers | Men | | |
| Average strength | | 8,783 | 1,482 | 84,700 | 1,192 | 18,203 | 480 | 114,840 |
| CAUSE: DISEASES | | | | | | | | |
| Primary | Secondary or contributory | | | | | | | |
| Abscess: | | | | | | | | |
| Brain | None | | | 2 | | | | 2 |
| Do | Hemorrhage, cerebral | | | 1 | | | | 1 |
| Peritonsillar | Abscess, lungs | | | 1 | | | | 1 |
| Do | Meningitis, cerebral | | | 1 | | | | 1 |
| Appendicitis, acute | Obstruction, intestinal, from paralytic causes. | | | 1 | | | | 1 |
| Do | Malaria | | | | | 1 | | 1 |
| Do | Peritonitis, acute, general | | | 1 | | | | 1 |
| Do | Peritonitis, acute, local | | | | | 1 | | 1 |
| Carcinoma, stomach | Pneumonia, lobar | | | 1 | | | | 1 |
| Cardiac arrhythmia fibrillation. | do | | | | | 1 | | 1 |
| Cellulitis, right side of face and neck. | Pneumonia, broncho | | | | | 1 | | 1 |
| Cellulitis, face and neck | Septicemia | | | 1 | | | | 1 |
| Cerebral hemorrhage | None | | | 1 | | | | 1 |
| Cerebrospinal fever | do | | | 6 | | 1 | | 7 |
| Delirium, alcoholic | do | | | | | 1 | | 1 |
| Dysentery, unclassified | do | | | | | 1 | | 1 |
| Glioma, brain | do | | | | | 1 | | 1 |
| Hernia, internal | Obstruction, intestinal, from internal causes. | | | | | 1 | | 1<br>1 |
| Influenza | Encephalitis, acute | | | 1 | | | | 1 |
| Do | Endocarditis, acute | 1 | | | | | | 2 |
| Do | Pneumonia, broncho | | | 2 | | | | 2 |
| Do | Pneumonia, lobar | | | 2 | | | | 1 |
| Lymphoma, general | None | 1 | | | | | | 1 |
| Mastoiditis, acute | Meningitis, cerebrospinal | | | | | 1 | | 1 |
| Mastoiditis, chronic | Pneumonia, lobar | | | | | 1 | | 4 |
| Measles | Pneumonia, broncho | | | | | 4 | | 1 |
| Meningitis, cerebral | None | | | 1 | | | | 1 |
| Meningitis, cerebrospinal. | do | | | 1 | | | | 1 |
| Nephritis, chronic | do | | | 1 | | | | 1 |
| Do | Dilatation, cardiac, acute | | | 1 | | | | 1 |

TABLE No. 2.—*Deaths reported, entire Navy, during the quarter ended March 31, 1928*—Continued

| Primary | Secondary or contributory | Navy: Officers | Navy: Midshipmen | Navy: Men | Marine Corps: Officers | Marine Corps: Men | Nurse Corps, nurses | Total |
|---|---|---|---|---|---|---|---|---|
| Average strength | | 8,783 | 1,482 | 84,700 | 1,192 | 18,203 | 480 | 114,840 |
| **CAUSE: DISEASES** | | | | | | | | |
| Otitis, media, acute | Meningitis, cerebrospinal | | | 1 | | 1 | | 2 |
| Otitis, media, chronic | Abscess, brain | | | 1 | | | | 1 |
| Obstruction, intestinal, from external causes. | Peritonitis, general, acute | | | 1 | | | | 1 |
| Pneumonia, lobar | None | 1 | | 10 | | 3 | | 14 |
| Rabies | do | | | | | 2 | | 2 |
| Sarcoma, mediastinum | Myocarditis, acute | | | | | 1 | | 1 |
| Sarcoma, thigh and lungs. | None | | | 1 | | | | 1 |
| Syphilis | Purpura hemorrhagica | | | 1 | | | | 1 |
| Teratoma, right hypochondrium. | None | | | 1 | | | | 1 |
| Tuberculosis, chronic pulmonary. | do | | 1 | 4 | | | | 5 |
| Do | Pneumonia, lobar | | | 1 | | | | 1 |
| Do | Tuberculosis, acute, pneumonic. | | | 1 | | | | 1 |
| Do | Tuberculosis, intestines | | | 1 | | | | 1 |
| Tuberculosis, pulmonary, acute, general, miliary. | Tuberculosis, intestines | | | 1 | | | | 1 |
| Tuberculosis, left kidney. | Tuberculosis, meninges | | | | | 1 | | 1 |
| Total for diseases | | 3 | 1 | 49 | | 23 | | 76 |
| **CAUSES: INJURIES AND POISONINGS** | | | | | | | | |
| Burns, multiple, gas fumes explosion.[1] | None | | | 5 | | | | 5 |
| Crush, left chest | Fracture, compound, ribs and left side. | | | 1 | | | | 1 |
| Drowning | None | 1 | | 7 | | | | 8 |
| Electric shock, injuries from. | None | | | 1 | | | | 1 |
| Fracture, compound: | | | | | | | | |
| Fibula, left | Septicemia | | | 1 | | | | 1 |
| Skull | None | | | 1 | | | | 1 |
| Do | Hemorrhage, cerebral | | | 1 | | | | 1 |
| Vertebræ and skull | None | | | 1 | | | | 1 |
| Intracranial injury | None | | | 3 | | | | 3 |
| Injuries, multiple: | | | | | | | | |
| Extreme | None | | | 2 | | | | 2 |
| Do | Hemorrhage, intraabdominal | | | 1 | | | | 1 |
| Do | Psychosis, manic, depressive | 1 | | | | | | 1 |
| Landplane crash: | | | | | | | | |
| Drowning | None | 1 | | 1 | | | | 2 |
| Injuries, multiple, extreme. | None | 5 | | | 1 | 4 | | 10 |
| Rupture, traumatic: | | | | | | | | |
| Liver | None | | | 1 | | | | 1 |
| Liver and kidney | Hemorrhage, intraabdominal | | | 1 | | | | 1 |
| Strangulation, hanging | Dementia, precox | | | 1 | | | | 1 |
| Do | Psychosis, epilepsy | | | 1 | | | | 1 |
| Wound: | | | | | | | | |
| Penetrating— | | | | | | | | |
| Abdomen | None | | | 1 | | 1 | | 2 |
| Do | Peritonitis, acute, general | | | | | 1 | | 1 |
| Abdomen and chest. | do | | | | | 1 | | 1 |
| Brain | None | | | 1 | | 2 | | 3 |
| Chest | None | | | | | 1 | | 1 |
| Do | Hemorrhage, traumatic, chest | | | | | 1 | | 1 |

[1] Gasoline explosion on board the U. S. S. Whitney.

TABLE No. 2.—*Deaths reported, entire Navy, during the quarter ended March 31, 1928*—Continued

| | | Navy | | | Marine Corps | | Nurse Corps, nurses | Total |
|---|---|---|---|---|---|---|---|---|
| | | Officers | Midshipmen | Men | Officers | Men | | |
| Average strength | | 8,783 | 1,482 | 84,700 | 1,192 | 18,203 | 480 | 114,840 |
| CAUSE: DISEASES | | | | | | | | |
| Primary | Secondary or contributory | | | | | | | |
| Wound—Continued | | | | | | | | |
| Punctured, arm, left. | Hemorrhage, traumatic, brachial artery. | | | 1 | | | | 1 |
| Multiple, extreme | None | | | | | 4 | | 4 |
| Poisoning, acute: | | | | | | | | |
| Alcohol, methyl | Dilatation, cardiac, acute | | | | | 1 | | 1 |
| Bichloride of mercury. | None | | | 1 | | | | 1 |
| Carbon monoxide | None | | | | | 1 | | 1 |
| Strychnine | None | | | 1 | | | | 1 |
| Total for injuries and poisonings | | 8 | | 34 | 1 | 17 | | 60 |
| Grand total | | 11 | 1 | 83 | 1 | 40 | | 136 |
| Annual death rate per 1,000, all causes | | 5.01 | 2.70 | 3.92 | 3.36 | 8.79 | | 4.74 |
| Annual death rate per 1,000, disease only | | 1.37 | 2.70 | 2.31 | | 5.05 | | 2.65 |
| Annual death rate per 1,000, drowning | | .91 | | .38 | 3.36 | | | .38 |
| Annual death rate per 1,000, injuries | | 2.73 | | 1.13 | | 3.30 | | 1.57 |
| Annual death rate per 1,000, poisoning | | | | .09 | | .44 | | .14 |

## STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following tables were constructed with figures taken from monthly reports submitted by naval training stations:

*Cumulative data*

| | Number | Per cent of recruits received | Per cent of recruits reviewed |
|---|---|---|---|
| JAN. 1 TO DEC. 31, 1927 | | | |
| All naval training stations: | | | |
| Recruits received during the period | 21,323 | | |
| Recruits appearing before board of medical survey | 937 | 4.39 | |
| Recruits recommended for discharge from the service | 554 | 2.60 | 59.12 |
| JANUARY, FEBRUARY, AND MARCH, 1928 | | | |
| United States naval training station, Hampton Roads, Va.: | | | |
| Recruits received during the period | 875 | | |
| Recruits appearing before board of medical survey | 41 | 4.69 | |
| Recruits recommended for discharge from the service | 41 | 4.69 | 100.00 |
| United States naval training station, Great Lakes, Ill.: | | | |
| Recruits received during the period | 973 | | |
| Recruits appearing before board of medical survey | 35 | 3.60 | |
| Recruits recommended for discharge from the service | 29 | 2.98 | 82.86 |
| United States naval training station, San Diego, Calif.: | | | |
| Recruits received during the period | 1,092 | | |
| Recruits appearing before board of medical survey | 32 | 2.93 | |
| Recruits recommended for discharge from the service | 32 | 2.93 | 100.00 |
| United States naval training station, Newport, R. I.: | | | |
| Recruits received during the period | 1,056 | | |
| Recruits appearing before board of medical survey | 76 | 7.20 | |
| Recruits recommended for discharge from the service | 28 | 2.65 | 36.84 |

**ADMISSIONS FOR INJURIES AND POISONING, FIRST QUARTER, 1928**

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the first quarter, 1928, is based upon all Form F cards covering admissions in those months which have reached the bureau:

| | Admissions, January, February, and March, 1928 | Admission rate per 100,000 per annum | Admission rate per 100,000, year 1927 |
|---|---|---|---|
| **INJURIES** | | | |
| Connected with work or drill | 565 | 1,968 | 2,913 |
| Occurring within command but not associated with work | 282 | 982 | 1,821 |
| Incurred on leave or liberty or while absent without leave | 97 | 338 | 1,097 |
| All injuries | 944 | 3,288 | 5,831 |
| **POISONING** | | | |
| Industrial poisoning | 2 | 7 | 37 |
| Occurring within command but not connected with work | 0 | 0 | 104 |
| Associated with leave, liberty, or absence without leave | 4 | 14 | 35 |
| Poisoning, all forms | 6 | 21 | 176 |
| Total injuries and poisoning | 950 | 3,309 | 6,007 |

*Percentage relationships*

| | Occurring within command | | | | Occurring outside command—leave, liberty, or absent without leave | |
|---|---|---|---|---|---|---|
| | Connected with the performance of work, drill, etc. | | Not connected with work or prescribed duty | | | |
| | January, February, and March, 1928 | Year 1927 | January, February, and March, 1928 | Year 1927 | January, February, and March, 1928 | Year 1927 |
| Per cent of all injuries | 59.8 | 50.0 | 29.9 | 31.2 | 10.3 | 18.8 |
| Per cent of poisonings | 33.3 | 21.2 | 0 | 59.1 | 66.7 | 19.7 |
| Per cent of total admissions, injury and poisoning titles | 59.7 | 49.1 | 29.7 | 32.1 | 10.6 | 18.8 |

Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addition," or "Alcoholism," as the case may be. Such cases are not included in the above figures.

The following cases, selected from January, February, and March, 1928, reports, are worthy of notice from the standpoint of accident prevention:

*Gasoline hazards.*—An explosion of gasoline fumes in which 1 man was killed and 1 officer and 11 men were injured occurred on board the U. S. S. *Whitney*, March 21, 1928. The cause of the explosion was reported as due to the ignition of vapor from gasoline which was leaking from a regular gasoline storage compartment of the vessel into an adjacent compartment which was being ventilated by a portable electric blower. Sparks from the motor probably

caused the vapor to ignite. Four of the injured men subsequently died. Reports of the other injuries have not yet been received.

*Gasoline, careless use of.*—The usual explosion resulted when a coxswain attempted to start a fire in the galley range of a destroyer with gasoline. He received burns of the back, arm, and chest and was treated in a hospital for 82 days.

*Gasoline.*—A can containing rags saturated with gasoline was left exposed in the engine room of a destroyer. Burns of the legs and arms were received by a fireman when the vapor became ignited. He was treated in a hospital 131 days.

A man was repairing a leak in the gasoline line of an automobile truck. He lighted a match and the resulting explosion caused severe burns of his hands and wrist. Loss of time, six days.

A man received severe burns of the hands, face, and feet when leaking gasoline in a motor boat was ignited by a lighted cigarette. He was transferred to a hospital, where he was treated for 77 days.

The fumes ignited and caused burns of the face of a marine when he lighted a match near an exposed can of gasoline. Loss of time, three days.

While a marine was soldering a leak in a gasoline tank, which had previously been washed out with water, the tank exploded. He was treated on the sick list for two days for an injury to his eye.

A man was holding a rag saturated with gasoline in his hand when another man standing near by lighted a cigarette. The gasoline was ignited and caused a burn of the hand. Loss of time, six days.

A petty officer at an air station carelessly lighted a match while he was pouring gasoline into a tank. His trousers were set on fire when the fumes ignited. In attempting to put out the fire his hand was severely burned. Loss of time, 12 days.

*Gasoline poisoning.*—A seaman was poisoned by gasoline when he swallowed some of the liquid while attempting to siphon it from a tank. Loss of time, 12 days.

A fireman on board a destroyer was poisoned by gasoline fumes while cleaning out an improperly ventilated tank. Loss of time, three days.

*Hatch-cover hazards.*—An improperly secured ladder gave way when a seaman attempted to close the hatch cover, causing a compound fracture of the radius when the cover fell on his arm. He was injured the last of December. The final result has not yet been reported.

A hatch cover fell, due to a safety device defective from use, while a seaman was passing through the hatch. Loss of time, 18 days.

*Hammock hazards.*—An apprentice seaman received a fracture of a clavicle when he fell from his hammock. It was reported that

he was thrown from his hammock, while asleep, by a petty officer. He was treated in a hospital for 15 days to the end of the year. The final report has not been received in this case.

*Flying particles—Lack of eye protection.*—Flying particles became imbedded in a boilermarker's eye when he was scaling a boiler with an air hammer. He was treated on the sick list for 21 days.

A machinist's mate received an injury to an eye from a flying piece of steel while using an electric drill. Loss of time, six days.

Another machinist's mate received an injury to an eye from a flying particle while working with an emery wheel. Loss of time, seven days.

These three injuries probably would have been avoided had goggles been worn, as required.

*Steam-line hazards.*—A machinist's mate, while working on a steam line, was severely burned about the arms, legs, and face when the supply valve was accidentally opened by another person. Loss of time, 12 days.

*Unsafe practice—Steam-line hazards.*—A fireman received severe burns of his body when he removed a valve from a steam line which had not been properly drained. He was treated in a hospital 11 days.

*Unsafe practice—Failure to use safety device.*—A seaman working with a power joiner without a safety guard, which was available, received lacerated wounds of his fingers. Loss of time, one day.

*Unsafe practice—Cleaning machinery in motion.*—An apprentice seaman attempted to clean a meat chopper while the blades were slowly revolving; result, lacerated wounds of three fingers, with three days on the sick list.

*Unsafe practice—Improper stowage of sharp objects.*—While descending a ladder a man stepped upon the sharp edge of a deck scraper which had been carelessly left on the deck. He received a lacerated wound of his left foot. Loss of time, four days.

*Lack of safety device—Explosion of water gauge.*—A water tender on board a destroyer received an incised wound of an eye when a water gauge not protected by a safety device exploded. Loss of time, 42 days in hospital.

*Careless handling of lye.*—A ship's cook engaged in cleaning the galley threw the contents of a can of lye into a pot of boiling water. He received burns of his face, neck, chest, and arms. Loss of time, 44 days.

*Fire caused by material probably defective.*—A coxswain received multiple burns of the face and arms during a fire in a motor boat of a battleship. This case was reported as "Cause unknown; material probably defective from use." Further information, although requested, could not be obtained.

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VOLUME XXVI OCTOBER, 1928 NUMBER 4

With Index to Volumes I to XXVI



# United States Naval Medical Bulletin

PUBLISHED *for the* INFORMATION OF MEDICAL DEPARTMENT *of the* NAVY

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VOL. XXVI OCTOBER, 1928 No. 4

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*Issued by*

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NAVY DEPARTMENT

DIVISION OF PLANNING AND PUBLICATIONS
CAPTAIN J. M. BRISTER, MEDICAL CORPS, U. S. NAVY
IN CHARGE

*Edited by*

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U. S. NAVY

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NAVY DEPARTMENT,
*Washington, March 20, 1907.*

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
*Acting Secretary.*

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Owing to the exhaustion of certain numbers of the BULLETIN and the frequent demands from libraries, etc., for copies to complete their files, the return of any of the following issues will be greatly appreciated:

Volume VII, No. 2, April, 1913.
Volume VIII, No. 1, January, 1914.
Volume VIII, No. 3, July, 1914.
Volume VIII, No. 4, October, 1914.
Volume X, No. 1, January, 1916.
Volume XI, No. 1, January, 1917.
Volume XI, No. 3, July, 1917.
Volume XI, No. 4, October, 1917.
Volume XII, No. 1, January, 1918.
Volume XII, No. 3, July, 1918.
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# PREFACE

The UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April, 1907, as a means of supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, reports from various sources, historical essays, notes and comments on topics of medical interest, and reviews or notices of the latest published medical books.

The bureau extends an invitation to all medical officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of commendation to authors of papers of outstanding merit and will recommend that copies of such letters be made a part of the official records of the officers concerned.

The bureau does not necessarily undertake to indorse all views or opinions which may be expressed in the pages of this publication.

E. R. STITT,
*Surgeon General United States Navy.*

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# U. S. NAVAL MEDICAL BULLETIN

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## SPECIAL ARTICLES

### RELATIONS OF PATHOLOGY TO DENTISTRY [1]

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#### INTRODUCTION

In the year 1926 the Carnegie Foundation for the Advancement of Teaching published a report by W. J. Gies on "Dental Education in the United States and Canada." This valuable document has served to extend interest in the subjects of education and research in dentistry and to stimulate discussion of both topics. Although not the first established, yet the oldest existing medical school in this country is that of the Universiy of Pennsylvania, founded in 1765. The first dental school was the Baltimore College of Dental Surgery, chartered in 1840. Three quarters of a century elapsed between these events. Gies attributes the separate establishment of dental schools to the "ignorance, intolerance, and professional vanity" of the medical authorities. It would be fruitless to deny the charge, but any implication that such an attitude on the part of the medical profession holds true to-day is probably not justified. Mother Science has a large family, and two of her children are medicine and dentistry. Looking at the family with the background of modern history, medicine can be thought of as the elder brother of dentistry. That permanent peace in any family is essential to its development is open to doubt. Struggles and differences, when clarified and settled, open the way to progress. The elder brother may assume a superiority due to his age and experience, but the younger brother may establish his security by endeavor and achievement. The trend of the times and the Gies report are resulting in an improvement in dental education whose growth can not yet be foreseen. With this goes an expansion of dental research which carries great promise for the future. The high-grade dentist and the high-grade physician have a mutual respect. The modern movement in dental education and research

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should extend this attitude throughout both professions. It is true that oral surgery in all its implications may be regarded as a specialty of medicine, but the field is so large that the specialty is almost as great as the tree from which it branches. The purpose of this communication is not that of a dissertation on differences in education and practice but rather an attempt to illustrate the interlocking harmony of purpose by an exposition of some of the problems to be solved by mutual investigations. Pathology is the science of disease, and in this field the two professions can find a common ground for attacking many problems. This does not exclude correlation of interests in the more fundamental biological and medical sciences and the clinical divisions of both medicine and dentistry.

### Nutritional Disturbances

The influence of nutritional conditions and diseases, and infectious systemic diseases, have been extensively studied as they relate to the teeth, both as to malformations and susceptibility to local disease. The influence of dental and periodontal infections upon infectious disease in the viscera has reached the stage of propoganda, which at times seems to have been deleterious to progress. The form and functions of the oral structures, the chemistry and bacteriology of the oral contents and the pathology of lesions in the cavity excite great concern. Anatomy and histology, physiology and biochemistry, pathology and bacteriology, have reached their highest development in the medical schools. The time is obviously ripe for a cooperative medical and dental attack upon many problems which deal with the mouth as an essential part of the whole organism.

#### DEFICIENCY OF VITAMIN D

The gross effects of rickets on the teeth is well known and all are familiar with the notches in the incisors representing the "small arc of a large circle." It is astonishing, however, that although this disease of nutrition has been studied so extensively in recent years, comparatively little attention has been paid to those factors which must underlie the obvious deformities of the teeth. The deformities in the bones have been thoroughly studied and it is apparent that the absence of so-called vitamin D and the consequent alteration of calcium and phosphate metabolism is the direct cause of these deficiencies in bone formation. The vitamin concerned may be reduced in quantity or entirely absent, and the resulting changes are in a general way proportional to the quantity of this vitamin in the diet. The teeth must be subject to dietary influences from the moment of their inception to the time of their complete formation. The diet of the infant *in utero* is supplied wholly from the maternal

blood stream. It is fairly uniform and, in case the mother's diet is improper, certain substances of the maternal organism may be reduced or depleted in order to provide for the infant. After birth the milk diet, either human or cow milk or some modification of the latter, is usually suitable to the needs of the new born. As the child matures, the likelihood of unsatisfactory dietary conditions increases and may be quite apparent before the deciduous teeth have reached their full development. At birth the incisors and, to a certain extent, the cuspids show an excellent shell of dentine and enamel, but the molars are less well developed. Therefore, with the increasing chance of dietary deficiency after birth, the molars, both first and second, are more subject to alteration on this basis than are the incisors and cuspids. Nevertheless, the nutrition supplied by the mother during gestation may be inadequate and the incisors be definitely affected. Toverud found a lowering of calcium in blood and saliva in the latter part of pregnancy and demonstrated in rats that deficiency in the diet of calcium and vitamin D results in the development in the offspring of teeth of an inferior chemical composition. M. Mellanby's work with puppies has given interesting results, which have been correlated to a certain extent with changes observed in human infants and children. Deficiencies in vitamin D, the "calcifying vitamin," or antirachitic factor, lead in puppies sometimes to grossly visible hypoplasia of the teeth, and practically always to microscopic alterations in both dentine and enamel. The layer of dentine may be thinner than normal and usually shows uncalcified interglobular spaces varying from minute size to collections of large spaces giving a foamy appearance under the microscope. The enamel may be thin and may also show the interglobular spaces, but not to the degree exhibited in the dentine. Similar changes are found in human deciduous teeth. Of particular interest is the fact that where only small amounts of vitamin D are supplied, the addition of large quantities of cereal, especially oatmeal, to the diet, augments markedly the deleterious effects. That the cereals have in themselves a definite anticalcifying influence is not yet established, but that they have a bad influence when in combination with reduction or absence of the calcifying vitamin is without question, for it has been demonstrated not only in animals but also in human children. Grieves's studies with McCollum's animals would indicate that a high calcium diet might in certain measure compensate for reduced vitamin D. The influence of these factors upon caries will be discussed subsequently. There are other problems that confront us. We must have sequential studies of the effects on the deciduous teeth. We must know to what extent the studies of deciduous teeth are applicable to the permanent teeth. We must learn the exact

effect of cereals. We must experiment with diets to determine the differential effects upon dentine and enamel. We must observe the relations between pulp and dentine and between tooth and periodontal structures. It is true that with an adequate diet injuries lead to a greater production of secondary dentine than is the case when vitamin D is absent, but that fact does not disclose all the features of interstitial cell activities in the process of repair.

### DEFICIENCY OF VITAMIN C

Another disease, fortunately not so frequent as rickets but nevertheless sufficiently common to cause concern, is scurvy. This disease, due to deficiency of water soluble vitamin C, found in fresh milk, fruits, especially oranges, certain vegetables, notably the potato, affects principally infants and children. As with rickets, the bony and other alterations have been extensively studied, but the changes in the teeth neglected. The hemorrhagic condition of dentulous gums is well known but the results of the disease upon the deciduous and permanent teeth are as yet obscure. Studies upon the teeth of experimental animals have been conducted by Höjer, and by Wolbach and Howe. These have yielded results of positive value, but the work must be regarded as incomplete. Wolbach and Howe studied the incisors of scorbutic guinea pigs. Beginning at the apex of the tooth, the blood vessels of the pulp near the odontoblasts become hyperemic and subsequently the pulp exhibits edema. The odontoblasts become smaller and more deeply staining. The odontoblast layer becomes detached from the dentine and in the course of a short time the separation is marked. Ultimately the entire pulp is completely separated from the dentine by a liquid material. Irregular deposits of calcium are observed in the odontogenetic zone and also in the pulp. Feeding of orange juice leads promptly to reestablishment of activity by the odontoblasts. The fluid becomes rapidly transformed to new dentine, following the outline of the irregularly shrunken pulp. This naturally produces two layers of dentine, probably of greater thickness than would eventuate if the growth of the tooth were not interrupted. No indication is given as to retrogression in the originally formed dentine, so it must be assumed that its nutrition is maintained. It thus seems likely that the fluid observed between individual odontoblasts and between odontoblast layer and dentine represents a product of these cells which under the influence of vitamin C becomes set and organized to form dentine. The more extensive work of Höjer and Westin indicates changes in periodontal structures, especially in increased porosity of the jaw and also of preformed dentine. The influence

of scurvy upon the later make-up of deciduous teeth and upon the anlage of the permanent teeth has not been disclosed. Changes observed in the herbivorous guinea pig may or may not be applicable to carnivora and omnivora. The processes of repair following injury of the teeth have not been examined.

### OTHER VITAMINS

The two examples given concerning dietary deficiency—namely, deficiency of vitamin D and vitamin C—show the most extensive but yet incomplete studies of these general phenomena as they affect the mouth. The influence of deficiency of vitamin A upon epithelium, notably of the eye and bronchi, has been carefully studied, and it is possible that a similar effect upon the enamel organ may be disclosed. It is at least conceivable that the antineuritic vitamin may exert an effect upon the pulp of the teeth. Growth promoting and other vitamins may not be without influence. The particular dietary deficiency that seems to be associated with pellagra has a profound influence upon the gums leading to inflammation and necrosis. It remains to be seen how this is reflected in the periodontal membrane and the teeth themselves.

### OTHER DIETARY SUBSTANCES

Of the other substances in the diet attention might profitably be directed to phosphates and salts of calcium, and perhaps other inorganic substances. Halisteresis, or the presumptive removal of calcium from bones already formed, is one of the great problems of the pathology of the bones, and probably also of the teeth. The tooth is a living structure, with blood and nerve supply and circulation of lymph (Fish). As such there is probably a change in content of its salts, perhaps with removal and replacement. Bones will not calcify properly if the supply of phosphates and calcium salts is inadequate, but we are not informed as to how far the teeth participate in this alteration. Under certain conditions, notably in osteomalacia, bones become softened by reduction in the amount of calcium and other salts. That the same phenomenon occurs in the teeth is still unproved, but is a topic of great importance. It concerns not only osteomalacia in its outspoken form but also less severe conditions in which the body's supply of calcium is drained, as, for example, in pregnancy and following severe operations. If the increasing incidence of dental caries in these states be due to calcium deficiency, the correction should be easy; but if not, the supply of salts, antirachitic vitamin, and radiant energy may lead us to a false position of security.

### Diet and Tooth Disease

Leigh's study of the teeth of ancient American Indians is of particular interest as regards the influence of the physical character of the food upon the permanent teeth. The Sioux, who existed largely on buffalo meat, show little or no attrition, caries, periapical abscess, or periodontoclasia. The Zuni, who more nearly approached civilized life in the pueblo villages and who had a mixed diet, show extensive caries, numerous periapical abscesses, and severe periodontoclasia. The Kentucky Indians and the Arikara, who used grains, ground by stone, show marked attrition and periapical lesions due to exposure and infection of the pulp. There is a little doubt that the food habits had much to do with the lesions found, but it is also probable that other environmental conditions may have played a part. The Zuni lived in houses, but in a sunny country. The Sioux were nomads. It is difficult or impossible to estimate the caloric content of the food and the balance of food elements, and our information about vitamin content is nil. The same is true of the studies of Hellman upon the skulls of Hindus, Australians, American Indians, and Eskimos, although the inference is that the meat diet of the Eskimo reduces the incidence of caries. Recent experience with hygiene of the teeth renders us skeptical as to its influence in determining lesions, and, of course, we have no information about the habits of these tribes. The formation of the Sioux teeth seems superior to that of the other tribes, and perhaps that is of significance in their preservation. Constitutional and dietary factors of early life can not be overlooked. Certainly the influence of abrasives in the ground meals is of significance in attrition, but such a factor plays little or no part in modern civilized life. Leigh's work with Eskimo skulls is not entirely in harmony with that of Hellman, who found 12.5 per cent carious. Leigh found only 1 per cent carious, but periapical abscess in 19 per cent due to tooth fracture, periodontoclasia, and pulp exposure the result of attrition caused presumably by chewing skins. The observation of one set of facts does not exclude the significance of other sets of facts, and we have much to learn of the influence of the diets of modern civilized life upon the teeth. When the information is at hand it should be possible to adjust diets so as to care for the needs of the body as a whole and at the same time provide for the conservation of the teeth.

### Systemic Diseases

#### SYPHILIS

Of the systemic diseases which have an effect upon the teeth, congenital syphilis is the outstanding example. The effects of acquired syphilis are numerous in the mouth and perhaps secondary effects

upon the teeth may be observed. Such results, however, are due to local alterations in the mouth rather than to the virus of syphilis per se. In 1857 Jonathan Hutchinson described the deformity of the permanent incisor in congenital syphilis. In contrast to rickets, the notch in the cutting edge has been described as the "large arc of a small circle," and for many years has been regarded as pathognomonic. This phenomenon has lost much of its importance with the discovery of the Wassermann test. In 1884 cuspal hypoplasia of the six-year molar was described by Moon, but this observation, supported by numerous observers, never attained, in the medical profession at least, the importance of the Hutchinsonian teeth. The histological characters of the defective teeth were described by Zsigmondy in 1893 and correlated with the embryology by Black in 1914. Particularly instructive was the study by Karnosh of the relations between the defect and the periods in the formation of the teeth. He points out that the period of significant effect of congenital syphilis upon the teeth is during the first year of postnatal life, concurrent with the period of stomatitis, snuffles, and the like. The defect is observed in the dentine, and more particularly in the enamel. Thus in the incisor there is underdevelopment of all three lobes, but especially of the incisal edge of the middle lobe. The enamel deposit of the first year is deficient but that of subsequent years is about normal. The dentinal hypoplasia also affects the six-year molar so that the cusps are poorly developed and close together. The prenatal deposit of enamel is good but that of the first year deficient and irregular, followed by better subsequent deposit. These demonstrations explain the lack of effect upon the deciduous teeth and the later permanent teeth. The lesion is not due to calcium deficiency or to other observable chemical changes. The question remains as to whether it is due to the syphilitic virus or to some secondary changes in the oral cavity. The child has syphilis long before the effects upon the teeth are observed, and usually continues to have syphilis thereafter. The visceral effects of syphilis are in general the result of delayed retrogression of mesoblastic structures. The effects upon the teeth seem more closely related to epiblast than mesoblast. The early postnatal manifestations of syphilis are upon the skin and mucous membranes and it may be that the operation of the virus in this direction is reflected in the enamel organ. If treatment of congenital syphilis were promptly inaugurated, would the effects upon the teeth be reduced or absent? Why, in a tissue composed of mesoblast and epiblast, are the effects more manifest upon the latter? Do the treponemata actually invade the tooth structure or is the effect due to the soluble products of the organism? If

stomatitis could be avoided, would the teeth still show deformities? The problems are numerous and require careful study both in the clinic and the laboratory.

### OTHER SYSTEMIC DISEASES

It is well known that transitory illnesses of childhood may leave their effects upon the teeth, especially in the form of local areas of deficient enamel formation. These may be the various infectious diseases of childhood, or nutritional disturbances especially referable to the alimentary canal. What of the more serious diseases such as tuberculosis? In adult life there are many diseases, systemic in nature, which might be expected to have an effect upon the teeth—malignant tumors, tuberculosis, diabetes, nephritis, etc.—but our information is at the best scanty.

### RELATIONS OF DEFECTS TO CARIES

The solution of the problems of dental caries will rest with the dentist, the physician, the bacteriologist, and the chemist. The interrelations of the problems call for the utmost in integrated correlated studies. Our purpose at the present time is not to go into the question of cause but to discover if nutritional disorders and systemic disease play a part in the incidence of caries. M. Mellanby's studies with deciduous teeth throw light on the subject, but require further examination in other countries and under other conditions. She demonstrated that many teeth are microscopically defective which grossly appeared to be normal. In a study of 1,036 deciduous teeth, 40.3 per cent of those with normal structure were found to be carious; 53.4 per cent of those with slightly defective structure, 95.7 per cent of those with definitely defective structure, 93.6 per cent of those with severe defects were found to be carious. The number of observations is large and the corresponding factor of error without much significance. It is, therefore, apparent that defective structure can be correlated with incidence of caries, and it seems safe to assume that these have the relation of cause and effect, as suggested also by the experimental work of Bunting. That this is the sole cause even in the cases studied can not be granted until the process of caries is better understood. That it is due to deficiency of calcium in the teeth is controverted by Fish, who found that carious teeth have a normal content of calcium. Among 266 permanent teeth in Mellanby's series there was none with normal structure. Six in 21 with slight defect were carious; 50 of 100 with definite defect and 116 of 145 with severe defect were carious. The number of observations is small and it is unfortunate that there

were no normal controls, but the results confirm the more extensive study with deciduous teeth. The summary states that—

Eighty-nine per cent of the teeth examined may be said to fit in with the general hypothesis that the susceptibility of a tooth to caries is directly related to its structure, while 11 per cent are against this hypothesis. An examination of the secondary dentine seen in the sections suggests that 72 per cent of these exceptions are probably due to the alteration of living teeth after eruption.

The clinical application was shown in a series of children studied over the course of about eight months. On a diet adequate in vitamin D and without oatmeal, the average of new carious points in the teeth was 1.4, whereas with a diet containing reduced vitamin D and considerable oatmeal, the average of new points was 5.1. This being the case, the question remains as to whether the dietary deficiency per se or through its influence upon the structure of the teeth was responsible for the caries. Stevens's observations indicate that caries of the decidous teeth leads to defective formation of enamel in the first permanent molar, but the mechanism is still to be discovered. It hardly seems necessary to detail the problems suggested by these various facts. How much do the defects incident to systemic disease influence caries? And if such an influence be demonstrated, is the effect due to the disease or its influence upon the structure of the teeth? Are the effects upon permanent teeth the same as those upon deciduous teeth? If not, what are the reasons for the difference? These and other questions indicate the field of exploration, and the breadth of the field indicates the necessity for cooperation and mutual interest among the explorers.

## Relations of Diseased Teeth to General Health

There are certain aspects of the relations of diseased teeth to general health that are concrete and reasonably well established, but there are others which verge on the borders of natural philosophy. Recent studies of cancer would make it appear that heredity plays a most important part in its incidence. The presence of jagged teeth and ill-fitting dentures is certainly associated with the development of cancer in the mouth. Throughout the body there are many instances in which prolonged irritation leads to the development of malignant disease. Yet it is well known that what appear to be equivalent degrees of irritation lead in some instances to cancer, in some to benign ulcer, and in some to no observable change. The explanation of these variations in reaction is by no means clear. Dentists and physicians may well cooperate in cases of cancer in the mouth to reach an understanding of the matter and thus agree upon an adequate prophylaxis and treatment. To say that the difference is due to hereditary factors is not entirely justified in our present

state of knowledge, and can not be until there is more extensive information concerning heredity in man. Slye's important studies on mice are not without contradiction and are certainly not as yet applicable to human pathology. The fact that in Simpson's series of cancers of the tongue 50 per cent gave a history of syphilis and 35 per cent a positive Wassermann test may well be of significance. If so, intercurrent disease may play a part in determining whether or not the irritation is to result in malignant change. There seems to be no other part of the body so favorable as the mouth for a study of the interrelation of chronic irritation, heredity, and intercurrent disease in the production of cancer. Another problem concerns cancer in the rest of the alimentary canal, especially in the esophagus and stomach. In both these situations it has been suggested that swallowing incompletely masticated food may, in accord with the theory of irritation, play a rôle. We have practically no information as to how far malocclusion or periodontoclasia or inadequate dentures are associated with cancers below the level of the mouth, either of themselves or by their influence upon habits of mastication.

### Microorganisms in the Mouth

The mouth is a moist, generally dark, warm chamber inhabited by many microorganisms, principally bacteria. Some of these are pathogenic, but require special conditions for their disease-producing activities. Transfer of pneumococci to the lungs and of meningococci to the meninges is well established but the mechanism of the process not completely understood. The most striking example of significance of organisms related to the teeth and periodontal structures is the connection between the spirochete of Miller and fusiform bacillus of Vincent and gangrene of the lung. These apparently symbiotic organisms occur in periodontoclasia and also about teeth and gums which are not the seat of demonstrable disease. They are almost constantly found in gangrene of the lungs. Kline found that impure cultures of these organisms will produce an abscess-like condition when injected into animals, but no gangrene. If, however, at the time of injection, the tissues be traumatized so as to provide dead material, gangrene promptly supervenes. Examination of the mouth of human patients with pulmonary gangrene usually shows severe periodontoclasia, and the same types of organisms are found both in the lungs and mouth. So far as we know these organisms do not occur normally in the lungs. Animals behave in the same way toward material from either the mouth or diseased lung. The chain would seem to be as complete as is possible without pure cultures. The method of transfer from mouth to lung is not positively known.

A fair assumption is that in the presence of an otherwise diseased lung the mouth organisms are aspirated and, lodging in deteriorated or dead tissue, produce gangrene.

### Pulp and Periapical Infections

There remains the question as to how great a part pulp and periapical infection plays in the development of systemic disease. Inaugurated by Rosenow and studied by Billings, Haden, and many others, widespread popularity has been gained by the idea that many of our systemic diseases have their origin in oral sepsis. This hypothesis depends upon two features, the rapid isolation of streptococci and the presumed elective localization of strains of streptococci. The isolation of pure cultures of streptococci is attended by difficulties known to bacteriologists but often overlooked by others. It took many months' continuous effort to obtain in pure culture the streptococcus of scarlatina. The organisms used in the experiments of Rosenow were obtained after 18 hours' incubation, and many critical observers are still doubtful of the purity of the cultures. Insistence on this point may seem overly meticulous, especially since enthusiasm has been shown above for the work on pulmonary gangrene, but the two propositions are different. The latter deals with a clearly defined species; the former deals with strain differences within a species. The fact that the diphtheria bacillus has a predilection for the throat, meningococci for the meninges, and pneumococci for the lungs does not support the hypothesis of Rosenow, for here we see species differences, not variations within a species.

### Elective Localization

The theory of elective localization depends upon the injection, principally into rabbits, of greening streptococci isolated from disease in various situations, the production in the majority of the animals of lesions in similar situations, and the recovery from these lesions of presumably the same greening streptococcus. In most of the experiments the incidence of the disease in 60 per cent of the experimental animals gives the assumption of elective localization. We are not adequately informed of the other lesions produced in these animals or of the lesions found in the other 40 per cent. In the work on gangrene all the inoculated animals were affected. If tubercle bacilli be injected into guinea pigs, all become tuberculous. If diphtheria toxin be injected, all become ill. There is a uniformity of effect in other established causative agents that is not exhibited in any of the series on elective localization. A critical point in the postulates of Koch is the recovery from the experimental lesion of

the same organism as was inoculated. Rosenow recovers a greening streptococcus from his animals. Holman has shown, however, that this organism is so common in laboratory animals which appear to be normal that it can hardly be given any significance. In a paper presented by Rosenow before the May, 1928, meeting of the American Association of Pathologists and Bacteriologists, he reported that he had recovered the greening streptococcus from 65 per cent of his animals inoculated with the organism, and from 25 per cent of animals not so inoculated. There is no positive means of distinguishing the greening streptococci occurring nonexperimentally in the animals from those injected, and until this can be done the experiments lack conviction. Furthermore, 80 per cent of the inoculated animals showed other organisms. The matter is of such far-reaching importance that it must be subjected to searching critical examination. Conclusive proof must replace promising assumption. It might be thought from general statements that Rosenow's work has been uniformly confirmed. It has been repeated with contradiction by McMeans and by Celler and Thalheimer, and by other competent workers.

### Practical Features

This sort of discussion may appeal to some as the hypercritical flights of a cloistered academic mind. The oral surgeon may say with an inclination induced by his field that the proof of the pudding is in the eating thereof. Doctors of medicine and dentistry, regarding the clinical aspects, have discussed the whole matter pro and con. Pathologists, in the seat of judgment, have necessarily entered the controversy. As one of the latter, I have been forced to certain views, which may or may not have value. Naturally one seeks for support of opinions rather than contradiction, and it is probably because of that manifestation of human nature that I quote the sympathetic views of a great clinician, L. F. Barker. He points out that nearly all the ills to which man is subject, alphabetically from appendicitis to zoster, are supposedly due to focal infections and emphasizes certain facts as follows:

> (1) That patients exhibiting the conditions mentioned do not always carry demonstrable primary foci of infection; (2) that when focal infections are present, certain other causal factors often cooperate with them in producing the conditions; and (3) that owing to the lamentable tendency in this country to push ideas to extremes, there has, during the past quinquennium especially, been clear evidence of overemphasis upon the importance of focal infections as a cause of both facol and general bodily disorders.

Consider the nature of the condemned periapical lesion. The abscess is a focal collection of pus, which in this position can extend only by involvement of bone, but is usually limited and small. That

it may have serious consequences is attested by the septicemias and deaths which not rarely follow extractions. Parenthetically we should emphasize the fact that although extraction is regarded as a minor operation the possibility of serious consequences should not be overlooked, and it may well be considered that extraction should be performed only under stressing circumstances when acute abscess is present, as emphasized by Blumer and others. The common course is for the abscess to become quiescent and transformed into the so-called granuloma. This is a scar tissue which may encapsulate a few bacteria. There is no good reason for considering that a scar in this situation differs from those in other parts of the body. We have instances in which the opening of a scar from a previous infection may result in a reestablishment of infection after many months, but in my experience two years has been the limit. In other words, the lapse of time provides for the disappearance of the vegetating bacteria. That such a scar as the dental granuloma would provide a source of more or less continuous discharge of bacteria into the blood stream is not supported by studies of other regions. Again quoting Barker:

> The mere presence of bacteria in a pulpless tooth, or in tissues about it, can not be regarded as sufficient evidence that the body is being injured by such bacteria or even menaced by them. If you will recall that the skin and the mucous membranes of the mouth, the nose, the paranasal sinuses, the tonsils, the pharynx, the respiratory tract, and gastrointestinal tract always contain bacteria, pathogenic as well as saprophytic in type, you may perhaps be somewhat less afraid of bacteria in the gums and in pulpless teeth.

Further:

> The fact that the bacteria from such a pulpless tooth, when injected beneath the skin of a rabbit, may sometimes do harm to the animal affords no proof whatever that the retention of that tooth in its normal position in a patient's mouth has been doing him any harm.

It is well known that when two infections are simultaneously present, the removal of one may benefit the other. This can account for the favorable results which sometimes follow removal of focal infections, but in no way correlates the two etiologically. The therapeutic test is no longer regarded as proving anything, for the psychological effect of various treatments is now well known and indeed unscrupulously exploited. Patients report improvement in general health following removal of infected teeth, diseased tonsils and gall bladder, appendix, and other structures, individually or collectively. They subject themselves to a more or less extensive surgical repair and eliminate disturbing elements in that ideal state of adjustment to environment commonly called health. The removal of hemorrhoids usually has the same effect, but that these itching, painful, bleeding varices are points of focal infection is not often claimed.

The removal of cystic ovaries and of tumorous uteri is often followed by remarkable improvement in health, without the slightest trace of infection in the offending organs. Fitting the body to function without sensory or physical disturbance makes for good health and is a duty of physicians and dentists, but the results should not be too freely ascribed to hypotheses with little or no scientific proof.

Medicine and dentistry are divisions of biology, and biology is not as yet an exact science. Factors of error are all too frequent and often can not be evaluated. The use of experimental animals may provide conditions more favorable than human material, but even here there is much to be done in establishing normal standards for comparison. Being what it is, the setting up of hard and fast rules in biology has not yet been possible. The general surgeon has no set rule for operation in all his cases, and the dental surgeon can not expect that he can have a fixed rule to follow in the management of infected teeth.

## Conclusion

The future welfare of dentistry depends upon research. To be fruitful the research must be conducted by properly trained men. Without additional training and experience, the education provided in the old-fashioned dental schools is utterly inadequate for productive work. With the recognition of the inherent relations between medicine and dentistry, dental education is undergoing a revolution, which will be highly beneficial to all concerned. The specialties of medicine require a groundwork in general medicine. This can be interpreted as a groundwork in general pathology. No division of special pathology can be effectively pursued without a comprehension of the features of general processes. This applies with equal force to surgical pathology, ophthalmologic pathology, dental pathology, and all the other restricted fields. I have said that medicine is applied pathology. Rufus Cole has replied that pathology is medicine. It is also surgery, gynecology, dermatology, dentistry, and all the rest.

The technical problems of dentistry have been extensively studied in the clinic and in industrial establishments. The literature reveals many concrete facts and well-established hypotheses. If the dentist wishes information on any technical problem, he has a wealth of published material to consult. The situation is different as regards those problems which reveal the medical aspects of dentistry. The relatively few publications leave one in much doubt as to what constitutes established fact or concensus of opinion. Many of these studies are well conducted, but all are subject to biological factors of error. We must provide for adequate training of logical minds, endowed with productive imagination, alertness, and inde-

fatigable energy. These may be dentists or physicians working in laboratory or clinic, but they must be productive. Dental research has shown high quality in many instances, but the future calls for improved quality and vastly increased quantity.

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## OUR DISEASE INHERITANCE FROM SLAVERY[1]

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One of the most remarkable facts in the history of the world's civilization is the existence in Greece, during the fourth and fifth

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centuries before Christ, of leaders in art, philosophy, poetry, history, and politics whose reputations hold to this day as supreme in their spheres. Where can you find greater names in art than those of Phidias and Praxiteles? Who among the philosophers excels Socrates, Plato, or Aristotle? Where do we find more brilliant statesmen than Pericles and Demosthenes?

It is equally remarkable that this unparalleled culture, instead of gaining greater heights in succeeding years, should have retrograded, so that by the time of the Roman invasion there was no longer the intellectual and physical excellence which characterized the Athens of Pericles.

Many explanations have been advanced for this cultural decadence, and it is certain that destructive wars, particularly the Peloponnesian War, played an important part. Then, too, the restrictions on citizenship, which held in most of the states of Greece, must have aided the decline. Devastating diseases, which always accompanied the wars of former periods, and continued after the wars, must have been powerful factors in mental as well as physical decline.

The influence of malaria in bringing about the decline of Greece has been considered by many writers, but in his work, Malaria and Greek History, W. H. S. Jones has presented convincing evidence, by reference to the medical writers of ancient Greece, that, from an epidemiological or pathological standpoint, no other cause could be accepted than malaria. He admits the probability that other influences were operative, but these, in the absence of malignant tertian malaria, would not have sufficed to destroy the greatness of Greece.

In this analysis and interpretation of the writings of the great writers of ancient Greece, by Jones, we have a classical study of the effects of a single disease on the physical, intellectual, and moral conditions of a great race.

If one should read the dismal prophecy, made by Manson in his Lane lectures, as to the effects of the introduction of yellow fever into the Orient through shipping passing through the Panama Canal, it would suggest a disaster unequaled in the history of the world.

Serious study has also been made of the hosts to be found in the United States which might favor the endemicity of important helminthological infections now found only in those who have lived in the Orient.

With these instances of actual or hypothetical effects, following the introduction of diseases into a population, it has occurred to me that a presentation of this subject, as it affected the people of the Southern States through the importation of African diseases, would be of interest.

Before taking up the diseases which we might consider as of African origin it would seem well first to give attention to the illnesses which existed among the Indians at the time of the coming of the European colonists.

### Diseases Among the Indians

There seems to be general agreement among those who have written about the Indians that rheumatism was of frequent occurrence. Alimentary-tract derangements were very common as the result of excesses in eating. Kennard states that the Indians suffered much from their imprudent stuffing with meat and every fruit, green or ripe, that they could find. They had no regular hours for meals, but the pot was kept continually boiling while there was anything in camp and everyone was permitted to feast without restraint. When they killed buffaloes they stuffed themselves ad libitum, eating liver, tripe, and intestines. On such occasions they did nothing but eat and sleep, often feasting 20 times a day. The same writer also calls attention to the fact that from necessity the Indian will fast for several days. In all probability this enforced fasting was a saving grace.

There is abundant evidence that conjunctival diseases—probably trachoma—were very common among the Indians of the western plains.

In his experiences with the Indians, Hunter noted that their diseases were for the most part simple and relieved by simples. He states that they were subject to but few febrile disorders, and these chiefly intermittents.

In my opinion the evidence is strongly against the existence of tuberculosis among the Indians prior to its introduction by the whites. The same Hunter quoted above states that pulmonary consumption does not at all exist among the Indians. Benjamin Rush was of the same opinion.

*Tuberculosis.*—In his painstaking investigation of this problem Hrdlička gives certain references which suggest the existence of tuberculosis in the pre-Columbian period. He quotes Matthews as stating that the wildest Indians in the earliest historic times were subject to consumption. Discredit is thrown on this observation by Matthews's later statement that modern Indians are troubled by a different form of the malady. However, many of the references cited by Hrdlička bear testimony to the absence of the disease prior to its introduction from European sources, and Hrdlička, himself, is of the opinion that tuberculosis did not exist on the American continent.

The views of Hrdlička as to the improbability of pre-Columbian tuberculosis are strikingly expressed in the following quotation:

* * * That it was rare, if it did exist, may be judged from the following indications: (1) No reference to the prevalence of this disease among the Indians is made by the writers who reported on the period of the earliest contact of the whites with the various tribes. (2) There are to this day among the Indians a scarcity of remedies and a lack of specialized forms of treatment for this disease. (3) In many tribes the testimony of the old Indians is to the effect that diseases of the kind were unknown or but seldom seen among them in their early days or in the still earlier times of which information had come down to them. (4) The old men and women in many of the tribes are remarkably free from signs of tuberculosis of the lymph nodes and bones. (5) The whites who have been long in contact with the Indians, particularly in the Southwest, all speak of the spread of the disease within their memory, while the observations of explorers and men of science indicate a progressive decrease in most localities as we recede into the past. (6) As yet no bones of undoubtedly pre-Columbian origin have been found that show tuberculous lesions, and such lesions are very rare in Indian bones dating from the period of the earliest contact with the whites. (7) The Indian presents everywhere a greater susceptibility to the disease than the white man; this means a lesser immunization of his system, indicating the more recent introduction of the infection into his race. (8) It is to be assumed on purely logical grounds that the disease must have been much less frequent among the Indians in former times, when they lived a more natural and active life, were better inured to hardships, and, with exception of particular localities and periods, were better provided with suitable food.

There would not seem to be any doubt about the whites having introduced measles and scarlet fever, the disastrous effects of which when communicated to the Indians are attested in various writings.

*Smallpox.*—Of the exanthemata the one which undoubtedly did more to decimate the aborigines of the New World than all other diseases and warfare combined was smallpox. One author has expressed this as follows: "The horrible details of its ravages are sickening to read." All evidence attests the introduction of this disease by the whites. The stories we read of the wiping out of whole populations in Mexico and Central America following the Spanish conquest are connected with smallpox rather than warfare.

It is probable that the mild type of smallpox in the West Indies, commonly known as alastrim, had its origin in African importation, as central Africa has been recognized as probably one of the original foci of smallpox. In his book, Diseases of Negroes in the West Indies, Thomson brings out the interesting observation that the practice of inoculation was known from remotest times in Africa, even before the introduction of Mohammedanism. The slaves termed it buying the smallpox, as the parents expected a fee for the material taken from their child. There is therefore good reason to suppose that smallpox came in with the slaves from Africa, but this importation was unimportant as compared with the introduc-

tion of the disease by European settlers, in whom we had a strain of variola similar to the fatal strain common to the Orient.

*Syphilis.*—In my opinion, the sole basis for the story of syphilis being a New World disease is one of coincidence, the spectacular spread of this social evil in Europe having occurred about the time of the first voyages of Columbus. As I shall later point out, I believe it is more probable that syphilis was introduced into Europe from Africa. Rush states that the venereal disease was given the Indian by Europeans, and in many of the articles I read in connection with this paper I have noted the close connection between syphilis and alcohol, both importations of western civilization. Hrdlička found abundant evidence of syphilis in his examination of bones from Indian graves subsequent to European colonization, but prior to that period no trace of that disease was noted, the bones showing only the reactions commonly associated with injury.

In Rush's essay on the natural history of medicine among the Indians of North America I note that he refers to dysentery as an Indian disease. In view of the present recognition of the influence of the mind on disease I was interested to read the following paragraph in the essay just referred to:

> The Indian submits to disease without one fearful emotion from his doubt of its event and meets his fate without anxiety for the future, but among civilized nations the influence of religion has converted the fear of death into a disease.

Rush also writes that he has not been able to find a single instance of madness, melancholy, or fatuity among the Indians.

### Diseases Introduced by European Colonists

It had been my plan to set before you the diseases which might be regarded as existing in Europe at the time of the coming of the colonists to America and with this in view I have done much reading along this line, but for the safe of brevity I shall pass this over, and in fact we are justified in considering that those diseases not existing among the Indians and those not brought in with the slaves from Africa may be regarded as of European importation. Of course, I am not unmindful of the rare cases of leishmaniasis, clonorchiosis, paragonimiasis, etc., reported from Asiatic sources, but these infections do not seem to have acquired suitable intermediate or definitive hosts in the United States.

In particular have I read the works of Dr. Thomas Sydenham, and while he describes in a remarkably clear manner such diseases as tertian and quartan fevers, measles, smallpox, acute rheumatism, renal colic, dysentery, scurvy, and, in a manner never equaled, the gout, yet when it comes to fathoming the nature of the various fevers

he has described under such designations as continued fever, depuratory or cleansing fever, pestilential fever, stationary fever, epidemic intercurrent and essential intercurrent fevers and these again being associated with clinical differences in the various years of their occurrence, I must admit I can not associate these fevers with any of the fevers of which we now have so distinct an understanding.

As regards these descriptions I feel about Sydenham as did Rush about Hippocrates when he said:

I honor the name of Hippocrates; but forgive me ye votaries of antiquity if I attempt to pluck a few gray hairs from his venerable head. I was once an idolator at his altar, nor did I turn apostate from his worship till I was taught that not a tenth part of his prognostics corresponded with modern experience or observation.

### Diseases Probably Introduced from Africa

In contrast with my uncertainty as to the fevers described by Sydenham I had little difficulty in identifying the various diseases noted by writers of the latter part of the eighteenth century as affecting the slaves brought over from Africa. Again these authors frequently called attention to certain diseases which at the time of writing prevailed exclusively among the slaves as liable to spread to the white colonists.

*Blackwater fever.*—As many of you may know, one of the puzzles of medical history is the comparatively recent recognition of that striking disease, blackwater fever, the first description of which came from Lebeau, who reported this markedly asthenic affection with its rapidly appearing jaundice and dark colored urine from Madagascar in 1850. We now know that it is endemic in West Africa as well as in the West Indies and certain of our Southern States, and I had hopes, as I carefully read the literature of my subject, that I might come across some mention of its symptom complex. Of course, there was much written about bilious remittent fever but the clinical history did not fit blackwater fever.

We know that the malignant tertian infections of Italy fail to be associated with blackwater fever while that of the Guinea coast is provocative. It would seem reasonable to consider blackwater fever in the United States as secondary to the malignant tertian infections brought in by the slaves.

*Tropical malaria.*—I frequently ran across statements that the slaves did not seem to suffer from the intermittent fevers which affected the whites, a fact which we would expect when we consider the rarity of benign malarial fevers in the regions from which the slaves came. There is no doubt, however, of their having suffered severely from malignant tertian malaria, and in James Thomson's book on diseases of negroes I found, under the designation of low

nervous fever, a wonderful description of tropical malaria. It is described as starting with irregular cold shiverings and lassitude or commencing more abruptly with pain in the back and prostration.

The pain of the head is intolerable, the heart beats violently, and the breathing is hurried but not complete. The fever excites a burning, biting heat of the surface. Urine high colored and passed in small quantities. Toward evening a low kind of delirium comes on, the patient being confused so that one has to repeat the question several times before being answered. There is constant watchfulness but toward morning the symptoms mitigate and the patient dozes. We may not give stimulating remedies but the fever returns with greater delirium and dry parched tongue. The patient continually mutters to himself. A cold clammy sweat succeeds but without relief of symptoms. The returns of fever are irregular and when we least expect them. The fever usually terminates on the eleventh, fourteenth, seventeenth, or twenty-first day.

There can be no question of this importation of tropical malaria and while malignant tertians undoubtedly prevailed to some extent in Europe during the early period of colonization of America, yet I believe we must attribute the severe malaria of our Southern States to African importation.

The anopheline mosquito was present and transmission to the white population would naturally occur.

*Dysentery.*—As regards dysentery I had always entertained the idea that our amœbic dysentery and tropical abscess were largely importations from Africa, but I could find very little evidence to support this view.

There was frequent reference to the common occurrence of dysentery in the slaves, but the clinical and pathological picture was that of bacillary rather than amœbic dysentery.

Thomson notes that in the more severe form of the disease there is sudden and great prostration, so that in 14 hours the strongest negro is scarce able to help himself. Tormina is excessive and evacuations are most frequent and are often followed by prolapse of the rectum. Death often occurs by the fourth day. Thomson posted many of his cases and found the mucous membrane highly inflamed and covered with bloody mucus but without ulceration. The liver was almost never diseased. From the pathological and clinical considerations Thomson regarded this dysentery as different from that occurring in Europeans. It would be hard to find a more vivid description of the horrors of the slave ship than that given by Winterbottom of the devastating effects of dysentery on the victims, when out of the cargoes of several vessels consisting of 600 or 700 slaves each, dysentery killed 250 on one ship, 220 on another, 150 on a third, 60 on a fourth, and 82 on the fifth one of the squadron. He notes the frequency of the disease in the Gold Coast, where the badness of the weather or water renders it very prevalent.

*Hookworm disease.*—Given the problem of the introduction of so notorious a soil pollution parasite as the hookworm (in which infection man is the sole host) and along with this provide conditions of primitive feces disposal and any epidemiologist would give the opinion that the disease would spread widely.

That this parasite was introduced by the slaves seems well established. Under various designations, such as mal d'estomac, malacia, dirt-eating disease, etc., I found frequent reference to the common occurrence of such a disease among the slaves. In view of the usual opinion that hookworm disease is less severe in the colored race than in the white one, I was surprised to find in the old descriptions of the disease that of a most serious affection.

Take, for instance, Williamson's notes about stomach evil, as he designated it:

> Depression of spirits, languor, listlessness, disposition to extreme indolence, laborious breathing, inability to ascend a hill, such effort increasing heart action.
>
> Appetite declines, a puffed appearance takes place over the body, particularly the face. If an effort to walk is made they have to lie down from giddiness and weakness.
>
> Increasing debility makes rapid progress and terminates most commonly in death. Prevalence of the disorder in the West Indies is extensive.
>
> It is generally imagined that these symptoms are occasioned by dirt eating. They are supposed to prefer cretaceous or absorbent earths, but they will pick plaster from interior walls, which seems equally acceptable.
>
> We have seen every symptom of stomach evil in negroes who have apparently not been dirt eaters. We have seen negroes lead a slothful existence for one or two years without any hope of recovery, but more frequently it runs its course in two or three months, and I have known it to terminate fatally in three weeks.

You will agree with me that the above is an excellent record of hookworm disease. If we were to add to this the laboratory findings of to-day we should be at a loss to improve on it.

When I was in Egypt in 1905 I had the opportunity of visiting Professor Looss, the great helminthologist. Just prior to that time he had noted the presence of the New World hookworms in the stools of pygmies from central Africa. This finding was regarded as attesting the source of the infection in our Southern States, and, of course, we now know that *Necator* is the common parasite of west Africa rather than *Ancylostoma* of Egypt and southern Europe.

You will remember that Doctor Stiles reported the presence of this new genus of hookworms in 1902. I remember his saying in a lecture that only a year or two before he had suggested to a medical audience, that from epidemiological grounds, ancylostomiasis should be quite prevalent in the sandy sections of the Southern States, having in mind the favorable soil and climatic conditions and the known

existence of the infection in the slaves. Very interesting was his story that in the discussion which followed he was flayed by Osler, who remarked that the suggestion of the widespread existence of such a disease without its recognition by physicians was an insult to the medical profession. And yet, a few years later estimates of the number of hookworm cases in our Southern States, varying from 2,000,000 to 5,000,000, were made by different investigators.

The improvement in the efficiency of many groups of mill operatives and others, especially school children, following treatment for hookworm disease, is well known to all of you. A little more than 100 years ago the following article, dealing with diseases on the Roanoke River, was written in the Medical Repository:

> Malacia, or dirt eating, as it is called, is endemic in this country. Dirt eating prevails mostly among the poor white people and negroes, and originates, in my opinion, from a deficiency of nourishment. It might be asked, if want of nourishment is the cause of dirt eating, why do not the poor of the Northern States eat dirt? A scantiness of nourishment in a northern climate does not produce the same debilitating effect on the constitution that it does in a warm, moist, relaxing atmosphere. The system requires three times the quantity of stimulus to sustain vigour or health in this country than it does in a northern country. No person who is unacquainted with the extreme poverty of the lowest class of people, who live in this country of slavery, can have a full and clear idea of the destructive effects of a long and continued deficiency of nourishment. It is impossible for the poor to get employment; every person who has any property in this country has generally slaves enough, and more than enough, to do anything he wants done; so that the poor can not get a shilling a day for their labour, which will not afford a diet sufficient to support the system in health in a climate where so much stimulus is necessary. Stupidity of mind, torpidity of the whole system, evince a complete state of asthenia. Nature prompts the poor miserable creatures in this situation to the use of alkalies for relief; hence they begin with chalk, burnt oyster shells, dry clay, or any other substances they can get, of an absorbent or alkaline nature. Malacia, so far as my knowledge extends, has seldom been cured in this country; and as seldom is there any opportunity of regular treatment, in consequence of the poverty of the sufferers.

*Sleeping sickness.*—There can be no question about the occasional introduction of African trypanosomiasis with the slaves, as we find the presence of this disease in these people noted by various writers from the West Indian Islands.

Winterbottom, in his book, An Account of the Native Africans—and An Account of the Present State of Medicine Among Them, has some interesting paragraphs about this disease, from which the following may be quoted:

> The Africans are very subject to a species of lethargy which they are much afraid of, as it proves fatal in every instance. The disease is very frequent in the Foola country and is said to be much more common in the interior parts of the country than upon the seacoast. It is not more common among the slaves than among free people, though it is asserted that the slaves from Bemin

**are very subject to it. At the commencement of the disease the patient has commonly a ravenous appetite, eating twice the quantity of food he is accustomed to eat, and becoming very fat. When the disease has continued some time, the appetite declines, and the patient gradually wastes away. Squinting occurs sometimes, though very seldom in this disease, and in some rare instances the patient is carried off in convulsions. Small glandular tumors are sometimes observed in the neck, though depending rather upon accidental circumstances than upon the disease itself. Slave traders, however, appear to consider these tumors as a symptom indicating a disposition to lethargy, and they either never buy such slaves, or get quit of them as soon as they observe any such appearances. The disposition to sleep is often so strong as to scarcely leave respite for the taking of food. Often the repeated application of the whip, a remedy which has been frequently used, is hardly sufficient to keep the poor wretch awake. The disease usually proves fatal within three or four months.**

Undoubtedly we should have had here such devastating effects from this African lethargy or sleeping sickness as has been observed in recent years in Uganda, but for the fact that the arthropod host of the *Trypanosoma gambiense* is a tse tse fly, *Glossina palpalis*, and fortunately for us no species of this genus is found in the New World. The slave who arrived with this disease eventually died without in the meantime endangering others, due to the absence of the host necessary for the life cycle of the trypanosome.

*Leprosy.*—Most of the writers refer to the presence of leprosy among the slaves, and Hillary attributes the presence of the disease in the West Indies to African importation. I have read some excellent clinical descriptions of both nodular and nerve leprosy as noted for the slave population, but of present interest only in the fact that these case histories clearly deal with leprosy and not with elephantiasis. You may remember that we recognize in the United States three centers of endemicity for leprosy: One in California, due to Chinese importation of the disease; one in the Great Lakes region, connected with the coming of colonists from Norway and Sweden; and a third in the Gulf area, most probably of African origin.

The indications are that the United States does not offer a favorable habitat for this disease, in support of which I may cite the fact that Hansen investigated the descendants of 160 known Norwegian lepers, who came over to the Northwestern States, without finding a single leper among their descendants.

McCoy feels that in those cases of leprosy among Europeans or Americans, but contracted in the Tropics, which have apparently been cured following treatment in the United States or Europe, it should be insisted upon that the patients should not return to the tropics, but remain in the more favorable temperate region environment.

*Filariasis.*—Filarial diseases were certainly introduced by the slaves both into the West Indian islands, where these conditions are still

problems, and into our Southern States, which have scarcely been permanently affected by them.

Hillary in writing of elephantiasis makes the following statement:

> However we are certain that the negroes first brought it from Africa to the West Indies, where it is now too frequent among them, and among the white people also, who are not exempted from it.

Hillary describes both elephantoid fever and elephantiasis of the legs. While he does not describe elephantiasis of the scrotum or other parts, I find mention of such manifestations elsewhere.

A very remarkable circumstance is that only in the region surrounding Charleston, S. C., does there prevail in the United States an endemic center of filariasis. The infecting parasite is *Wuchereria bancrofti* (*Filaria bancrofti*). Francis, in his epidemiological study of this striking limitation, explained the matter in the following way: Evidently a large shipload of slaves coming from some heavily infected area in Africa must have reached Charleston, as they reached many of the West Indian islands. These slaves were probably retained in that locality for a sufficient time to spread the infection rather widely and to provide a permanent endemic center. There are certain points of difference between the transmission by mosquitoes of malaria and filariasis. A single malarial zygote develops into several thousand sporozoites, while the single filarial embryo, ingested with infected blood not only fails to multiply but stands numerous chances of destruction in its cycle of development in the thoracic muscles of the mosquito and subsequently when breaking through Dutton's membrane. Unless the blood of a filarial patient is heavily infected and taken up at night, in which period alone do the parasites appear in the circulating blood, the chances for transmission by the mosquito are slight. Then, again, if many embryos should be ingested by the mosquito this heavy infection may kill the mosquito host. The mosquito does not seem to suffer from a heavy *Plasmodium* infection.

Again, after obtaining entrance through the skin of the human host, male and female parasites must together reach a lymphatic gland, a further subjection to chance.

*Guinea-worm disease.*—Another filarial worm, the Guinea worm, *Dracunculus medinensis*, was often referred to as frequently present in the legs of the slaves, and Hillary states that it proceeded from drinking the waters of stagnant pools. This observation of his is in accordance with our present knowledge of the life history of the parasite, because the embryos, which burst forth from the protruding uterus of the worm, upon contact with any body of water in which the patient may be standing, are swallowed by small crustaceans (Cyclops), and when these hosts are taken into the stomach, by

drinking such cyclops-containing water, the infection is brought about. This infection does not seem to have established itself in the United States, but did become endemic in certain of the West Indian islands, from which it seems later to have disappeared.

*Loa loa.*—I can find no mention of the filarial infection known as *Filaria oculi*, more properly *Loa loa*, having become established either in the West Indies or in America.

The clinical manifestations of this disease attending the wanderings of the worm in the region of the ocular tissues or in the egglike swellings known as Calabar swellings do not seem to have been noted. In this infection the presence of a species of *Chrysops* is necessary for transmission. A species of this horsefly, *Chrysops discalis* is the transmitting agent of our recently reported American disease, tularemia.

*Rectal bilharziasis.*—A trematode infection, due to *Schistosoma mansoni*, is present in various parts of Africa and must have been frequently introduced by the slaves, but does not seem to have established itself in the United States, as it has in certain of the West Indian islands and in Brazil. Clinically we have a rectal involvement giving rise to prolapse and ulceration of the rectum. (*Planorbis* is the mollusc host.)

*Yaws.*—I now come to a subject which has puzzled me for many years, and that is the failure of a disease, which was quite common among the slaves, to get a foothold in our Southern States. The disease I refer to is yaws. In almost all of the old books dealing with diseases of the West Indian slaves I find excellent clinical descriptions of the disease, and all refer to its infrequency in the whites and even among the mulattoes, which latter class must have been almost equally exposed to the infection with their kindred. Then again, I find accounts of the disease in white people in whom on their return to England the disease was diagnosed as syphilis. I found one very well-described case in a refined woman who was said to have contracted the yaws from her husband. Upon her return to England the case was diagnosed as syphilis. The patient left England in disgust to return to the care of West Indian physicians who had a proper knowledge of the disease.

We know that yaws is a common disease of parts of both the East and West Coasts of Africa and we certainly know that it was a disease which gave great concern to the slave owners in the New World, by reason of its incapacitating effects and its tendency at times to spread in almost an epidemic fashion.

In his article on yaws, Thomson states:

> Most people affirm that yaws is only capable of being propagated by actual contact. I am inclined to be of the opinion that actual contact is not required.

On many estates I have known it spread in a singularly rapid manner and attack negroes who, from their dread of it, have avoided every possible medium of communication.

One of the most remarkable features of this disease is its extraordinary limitation to tropical regions and its wide dissemination throughout the tropical belt. Besides tropical Africa and tropical America, we find yaws in the Malay Peninsula, Siam, Java, Ceylon, the Philippine Islands, Samoa, Guam, Fiji, and northern Australia. We have something of a clue to this remarkable limitation of the disease in a remark by Jonathan Hutchinson, to the effect that when Europeans contract yaws in the Tropics they return home with syphilis. The same author in his introduction to the classical treatise on yaws, by Numa Rat, writes:

If this disease is not syphilis, it is clear that it offers a very exact parallel to it.

The researches of modern times have demonstrated that the causative organism, *Treponema pertenue*, is practically indistinguishable from *T. pallidum* morphologically, tinctorially, and culturally. Inoculation experiments on monkeys would indicate certain distinctions, but many of these experiments are conflicting. Therapeutically, syphilis and yaws respond equally to mercury and salvarsan. A single classical and indefensible experiment was made by Charlouis in 1881 in inoculating a native suffering from tropical yaws with syphilis. It is reported that a primary lesion appeared at the site of inoculation to be followed by secondaries. Yaws, after running its untreated normal course, gives a complete immunity and, I think, to syphilis, too, but in the presence of the attack inoculation with yaws virus gives success. All authors refer to the practice of the natives of the Guinea coast in inoculating with yaws virus those yaws cases which failed to show full development of the eruption, with the idea that such a measure would prevent a striking in of the yaws. Our grandmothers had the same idea about measures to bring out the eruption of measles. If, then, yaws takes successfully on a yaws case, why rather should not the virus of syphilis, a cousin, brother, or dual personality, take on a yaws case?

This practice of the natives of inoculating yaws to bring out the eruption was followed by some of the physicians who dealt with the disease. Now I come to another striking fact about yaws. The naval medical men, serving in Guam for the last 25 years, have without exception stressed the absence of syphilis among the natives. Yaws is exceedingly common among these people, the Chamorros. The same facts holds for the Fiji Islands and for many of the sections of Africa where yaws prevails. In the writings about diseases of the

slaves I find frequent references to the nonexistence of syphilis among them.

Cases of syphilis, other than in the natives, have frequently been reported in Guam, so that opportunities for transmission of syphilis have been present. Again the native Chamorro sailors visiting Japan or China do not seem ever to contract syphilis, although gonococcus infection is common.

The most striking points of dissimiliarity between yaws and syphilis are that the primary lesion of yaws is generally extragenital and that of syphilis located in the genital region. Again, yaws is usually acquired innocently and syphilis through sexual intercourse.

Of course, we all know that syphilis may be contracted innocently and yaws acquired by coitus.

A distinction much insisted upon by medical men until recently was the absence of tertiary lesions in yaws. We now recognize the mutilating effects of yaws in the way of deep-seated ulcerations and caries of bone as paralleling those of syphilis.

Take the oral and nasal lesions of gangosa, now clearly associated with yaws, and I doubt whether any dermatologist could distinguish them from the well-recognized deformities of syphilis. Of course, we must recognize the apparent absence of central nervous system lesions in yaws, but the same fact is just as strongly stressed in connection with freedom from such involvement in the aboriginal races suffering from syphilis.

As stated previously, it seems to me that the view that syphilis is of New World origin lacks solid support. It is almost inconceivable that a handful of men (even if all of them were infected), such as returned to Lisbon from the West Indies, in March, 1493, could have spread syphilis abroad in Seville by the latter part of that month, and to Barcelona in April; thence in a few months more for Spanish and Portuguese soldiers to infect the courtesans of Naples and through these women carry the disease to the army of Charles VIII by 1494.

A knowledge of the big pox (variola grossa) existed one or two centuries before the time of the voyages of Columbus, and so well understood on the part of the dissolute was this disease in France, that elsewhere it went by the name of morbus gallicus. Torella writing about morbus gallicus, the center of which disease he considered to be Auvergne, noted that it invaded Spain from France in 1493.

Again, contemporaneously with the wide interest in syphilis noted in the latter part of the fifteenth century, we also had the knowledge of a specific for the disease in mercury. This information was apparently widespread, and it is against all medical experience to have an entirely new disease and its treatment appear simultaneously.

Anyone reading the articles by Sudhoff or Vorberg on the origin of syphilis must feel that there is insufficient evidence to support the New World origin of this disease.

I have been impressed by the rather strict lines of localization of yaws to rural or sparsely populated regions, in contrast to its absence from the cities of the country where it prevails. As a rule, syphilis is at the same time common in the cities. I have noticed this distribution or lack of distribution in the Philippines, and only recently one of our most capable medical officers serving in one of the rural districts of Haiti has referred to the great amount of yaws in his Province. All of our medical officers are familar with the prevalence of syphilis in the cities of Port au Prince and Cape Haitien, so that here we apparently have this same distribution. Recently I wrote to Captain Butler, then sanitary engineer of Haiti and one of our leading authorities in tropical medicine, for his opinion as to this distribution. In reply he wrote that after visiting this rural section of Haiti the disease was what was usually described as yaws, but that it was really only a form of syphilis.

I now quote from the writings of Sydenham, and in my opinion it is not improbable that the Father of English Medicine was not far from the truth when he attributed the syphilis of Europe to the importation of yaws from the Guinea coast:

> But to me it rather seems to have taken rise from some nation of the blacks upon the borders of Guinea, for I have been informed by men of great veracity who have lived in the Caribbee Islands that the slaves which are newly brought from Guinea, even before they land and likewise those that live there, are afflicted with the disease (innocently). Also that it seizes whole families—men, women, and children.
>
> And as far as I can learn this disease which so frequently attacks these miserable people does not at all differ from that we call the venereal disease with respect to symptoms—pains, ulcers, etc., allowing for diversity of climate. But it goes under a different name, for they entitle it the yaws. Nor does their method of treatment differ from ours, for they carry it off with a salivation raised by quicksilver.
>
> It seems to me that the disease was brought into Europe by Spaniards who first contracted it from negroes they had purchased in Africa, in parts of which the disease may be endemic, for the barbarous practice of exchanging natives for European merchandise prevails in many places on the border of Guinea. This contagious distemper spreading rapidly would have made the world a hospital and destroyed mankind. But, like vegetables, transplanted from its native place to a foreign climate, it flourishes less in Europe, languishes daily, and its symptoms grow milder.

Even if we were to accept the view that the yaws introduced with the slaves was responsible for some of the syphilis in the United States, we would have to hold the European importation as sharing in the introduction, and I think we must certainly blame the white settlers with the infection of the Indians, previously noted.

*Yellow fever.*—Another disease about which there is a question as to the original endemic center is yellow fever. The literature covering this discussion is so extensive and so controversial that it would require a paper equal in length to the one I have just read to cover the ground. I may, however, mention that there are advocates of the view that the original focus of yellow fever was on the coast of Guinea, and that the disease was brought to the New World by the slaves, or by mosquitoes imported with them. As the result of a careful consideration of this question I am of the opinion that the arguments in favor of the African origin of yellow fever are more convincing than those attributing this scourge to Carib, Maya, or Aztec sources.

The late Surgeon General Sternberg, one of the world's greatest authorities on yellow fever, thought it probable that the disease was introduced from the West Coast of Africa. "Indeed," he states, "in almost all places in America where it is now endemic, there is a history of a first importation and previous exemption. Again, conditions for endemicity in seaport towns did not then exist."

With the reporting by Noguchi of *Leptospira icteroides* as the cause of yellow fever, and his intensive study of its epidemiology, the African origin of the disease received less consideration. With the recent work in west Africa of Adrian Stokes and his colleagues of the Rockefeller Foundation, in reaffirming the findings of Reed and Carroll as to the filterability of the virus, and the limited period of its presence in the blood of human or monkey patient, we may again give weight to the views of Sternberg.

The immunity of the native monkey and the very great susceptibility of the imported one (*Macacus rhesus*) would suggest a monkey reservoir of virus for yellow fever in West Africa and add to the evidence that the disease was one of African importation.

## Conclusion

Summing up the probabilities of disease importation into our Southern States by African slaves we would seem justified in assuming that the malignant tertian malaria and its associated blackwater fever came from West Africa, where both of these diseases prevail extensively. Blackwater fever certainly was not brought in by the European colonists.

Bacillary dysentery was one of the scourges of the slave ships and was undoubtedly introduced into the colonies. The evidence I have been able to find as to the bringing in of amœbic dysentery is negative.

The restricted endemic area of filariasis in Charleston, S. C., offers an interesting epidemiological study. This disease, with its accom-

panying elephantiasis, was recognized in the West Indies as of African importation.

The Guinea worm was undoubtedly introduced into the American colonies, but failed to secure a suitable host. In the West Indies, however, it succeeded in establishing itself for a time, but later disappeared.

There can be no doubt that hookworm disease came in with the slaves. It would seem probable, in view of the assigning of the introduction of leprosy into the West Indian colonies to the slaves, that the endemic area of leprosy in the southern United States had a similar origin.

Neither the parasites of African sleeping sickness nor rectal bilharziasis seem to have secured a foothold in the United States, although the latter exists in certain West Indian islands. In the body of my paper I have dealt rather fully with the question of the introduction of yaws into the New World by the slaves. What became of this serious infection, which must have been brought into the American colonies, just as it was into the West Indian islands? Is the identity of syphilis and yaws the answer?

If, as I am convinced, yellow fever was introduced through slave ships into the United States by infected mosquitoes (which Stokes has recently shown can transmit the disease after three months) we have here a curse greater than any of the curses which the Egyptians suffered through their enslavement of the Jews.

## TREPONEMATOSIS AMONG THE BEDOUIN ARABS OF THE SYRIAN DESERT

By Ellis H. Hudson, M. D., Beirut, Syria

The following notes were collected in the course of three years' practice in the town of Deir-ez-Zore on the Euphrates River in the French Mandate of Syria. During nine months of the year 1927–28 approximately 1,000 patients were seen in the American Mission outpatient dispensary. Twenty-five per cent of these were Christian refugees and 75 per cent native Arabs (Moslems). Of these Arabs approximately one-half were inhabitants of the town of Deir-ez-Zore (population 15,000), one-fourth were Bedouin nomads of the desert, and the remaining fourth were farmers living in mud villages along the river banks. These townsmen, nomads, and farmers are closely related by blood. The economic level of the three groups is very low, especially that of the nomads and farmers who live very much as their ancestors must have lived some milleniums ago. The isolation of this region from civilizing influences has been practically complete throughout history, and one may be fairly sure that the diseases one finds present are displaying their pure biologic character,

unchecked and uninfluenced by treatment. The following observations and facts concerning treponematosis among the Arabs are therefore offered for what possible light they may throw on the diagnostic and immunological problems of spirochetal disease in general.

## BEJEL

The Bedouins have a disease which they call bejel. The practitioners of medicine (Syrian, French, etc.) who treat the Bedouins, universally refer to this disease without hesitation as syphilis. On the other hand, the Arabs themselves say this is not "faranghi" ("the foreign disease," syphilis) because they do not acquire it by sexual contact and because it does not manifest itself with a primary sore. Bejel is usually contracted in childhood, and apparent recovery follows quickly—i. e., within a few months. It is almost impossible to get the history of a primary lesion.[1] Almost every adult of the nomad or farmer classes is ready to state that he has had the disease "when small," as in the Occident one admits measles. The Arab does not expect to suffer from the disease more than once.[2 3 4 5] No stigma is attached to it, nor is it linked with the sexual act. It is not considered a venereal disease. The Arabs do not isolate those who have the disease; in fact, it is said that some of the tribes have transferred virus from sick to well children in order to induce mild cases of the disease, on the analogy of smallpox vaccination with which they are familiar.[6]

*Clinical description.*—When a father and mother bring their child suffering as they say from bejel what will the examiner find? Probably three things: (*a*) Catarrh of the nose and throat, (*b*) universal adenopathy, (*c*) a skin eruption. There may be a slight elevation of temperature and some enlargement and tenderness of the liver. Often there are "mucous patches" on the palate, and in the females soft papules about the labia. The teeth and palatal arches in these Arab children seem to be well formed; there are no rhagades, no iritis, except such as can be accounted for by trachoma present; no congenital deafness. No children have been observed with saddle noses, though soreness of the nose is often complained of in connec-

[1] Goodman, Herman: Frambesia tropica (yaws), with bibliography, Proc. Internat. Conf. on Health Probs. in Trop. America, 1924. United Fruit Co.

[2] Lacy and Sellards: Investigation of immunity in yaws, The Philippine Jour. of Sci., 30, *4*, August, 1926.

[3] Sellards, Lacy, and Schobl: Superinfection in yaws, The Phil. Jour. of Sci., 30, *4*, August, 1926.

[4] Schobl, Otto: Some factors in treponematous infection that influence the result of the Wassermann reaction, Jour. P. I. M. A., VII, *4*, April, 1927.

[5] Idem: Immunity in yaws, Jour. P. I. M. A., VIII, *1*, January, 1928, p. 6.

[6] Gutierrez, P. D.: Yaws, its manifestations and treatment by neoarsphenamine, Arch. Derm. and Syphil., 6, *3*, September, 1922, p. 265.

tion with the catarrh. The throat is sore, the voice thick, the tonsils enlarged; the tonsils, pharynx, and soft palate are all red with inflammation; discharge from the nose is plentiful; and there may be redness of the conjunctiva. The adenopathy is extraordinary; every chain that the examiner's fingers can reach is found to be palpable, the glands hard, shotty, discrete. The glands never soften, coalesce, or discharge. The skin eruption is macular or papular, or quite often a textbook circinate syphilid, with advancing papular border and clearing center, lobulated where two "figures" have coalesced.

*Illustrative case.*—Patient No. 887: Boy aged 9 years, brought diagnosed bejel by father who said he himself had had bejel 20 years before. Patient presents temperature of 37.8° C., catarrhal symptoms with sore throat and hoarseness, striking circinate skin lesions, and universal adenopathy.

We have been describing a child brought in with the acute stage of bejel. A later stage may present the following additional features: Ulcers on the tonsils, palate, and extremities; ulcerating mass in the nose with softening of the hard palate; multiform skin lesions; enlarged liver.

*Illustrative cases.*—Patient No. 432: Girl 12 years old, with mucous patches, pharyngitis, adenitis, condylomata, palpable liver. Patient No. 607: Woman of 35, with general adenopathy, presents ulcer on fauces 2 centimeters in diameter. (Ulcer healed rapidly under treatment with intravenous neosalvarsan.)

Finally, many adults not apparently suffering from bejel and coming for incidental conditions present on physical examination some variation of gangosa, or rhinopharyngitis mutilans.[7, 8] Usually when observed the disease process has already passed into scar formation. Saddle nose is not rarely seen in adults, sometimes with loss of the columella of the nose; some have the nasal voice of eroded hard palate, and in others scar tissue binds all the structures at the back of the mouth with bizarre bands.

*Illustrative cases.*—Patient No. 971: Girl of 14 years, with nasal voice, complains that water comes out her nose when she tries to swallow. Patient No. 670: Youth of 17 years, said to have had bejel as infant while nursing at the breast of a Bedouin wet nurse. Now his whole pharynx, soft palate, and fauces are replaced by a distorting sheet of scar tissue.

Occasionally an adult comes with complaint of falling hair or beard, as patient 572, aged 25 years. He admitted bejel, had marked adenopathy, and pharyngitis, and complained that, although he had

[7] Ayuyao, C. D.: Tertiary manifestations of yaws in the larynx, Jour. of P. I. M. A., V, *11*, November, 1925, p. 331.

[8] Idem: Tertiary manifestations of yaws in the nose and throat in the Philippine Islands, Jour. of P. I. M. A., VII, *11*, November, 1927, p. 411.

been "often married," he had not been able to procreate. (This is a very rare complaint among the Bedouins.) Patients have sometimes presented themselves with painful keratoses of the soles of the feet; others with ichthyotic shins, gummatous ulcers, and bone lesions.

*Serology.*—The preceding is an attempt to picture the main clinical features of the disease called bejel. When serum from these patients is subjected to the Kahn precipitation test it gives a strongly positive reaction. For the reliability and specificity of this test in treponematosis we refer to the work of Pineda and Wade in the Philippines.[9] Our statistics with the Kahn reaction are as yet too few for us to make a definite statement as to the prevalence of bejel in Deir-ez-Zore, but a short consecutive series indicates that among the nomads and farmers about three-fourths of the population would respond positively to the Kahn test. (See footnote for detailed analysis.) These figures are not presented as conclusive evidence of the presence of treponematosis among the Bedouin Arabs. However, they suggest that a certain disease giving a strong positive reaction with an antigen sensitive to treponemata is very common among them. This serological work will be continued. We may mention here the epidemiological rule of thumb that where 80 per cent of the population is proved to be infected the infection may be regarded as universal.

*Treatment.*—Unfortunately, under the circumstances of practice among such an ignorant and transient population, it is impossible to carry a patient all the way to healing after he once experiences improvement, nor is it possible often to follow up with subsequent examinations, physical or serological. There is at present no force propelling toward treatment except the individual's desire for it, a slender force, indeed, in the home of fatalism. However, whenever a patient with the lesions of bejel has subjected himself to treatment with neosalvarsan, sulpharsphenamin, or bismuth, singly or combined, his lesions have healed rapidly. Though there is no dramatic "cure in one shot," there is also no doubt that spirocheticides are specific for the disease.

Franklin, of West Africa,[10] reports the cure of yaws with novarsenobillon, and many writers [11] [20] [6] [1], etc., testify to the cure of both

[1] Goodman, Herman: Frambesia tropica (yaws), with bibliography, Proc. Internat. Conf. on Health Probs. in Trop. America, 1924. United Fruit Co.

[6] Gutierrez, P. D.: Yaws, its manifestations and treatment by neoarsphenamine, Arch. Derm. and Syphil., 6, *3*, September, 1922, p. 265.

[9] Pineda and Wade: The public health value of the Kahn precip. test, with special reference to yaws, Jour. of the P. I. M. A., VI, *6*, June, 1926.

[10] Franklin, J. C.: Treatment of yaws by novarsenobillon, Brit. Med. Jour., June, 1926, p. 943.

[11] Lopez-Rizal, Gutierrez, and Fernandez: Field experiment in the control of yaws, Philippine Jour. of Science, 30, *4*, August, 1926.

[20] Schamberg and Klauder: Study of a case of yaws (frambesia tropica) contracted by an American soldier in France, Arch. Dermat. and Syph., *3*, 49, January, 1921.

yaws and syphilis by neosalvarsan. Paterson, in East Africa,[12] suggests bismutho-tartrate of sodium and potassium for yaws, and Parsons,[13 14] in Haiti, is using bismuto-yatren A. and B. in treponamatosis. The preparations of bismuth which we have employed in treating bejel have given results decidedly inferior to the arsenicals. At the same time, attracted by its extreme cheapness, we are continuing its use, hoping to find a preparation of bismuth satisfactory in its method of administration and in its therapeutic results.

## COMMENT

If we are to link up bejel and syphilis as one and the same disease it is necessary to find other points of agreement. We do not encounter "congenital syphilitics." What about miscarriages? This question is hard to answer, because all matters pertaining to parturition are handled by the "old women." Inquiries about miscarriages are always subject to errors of misunderstanding, bad memory, and willful misstatement. Though miscarriages are frequently reported they are not out of proportion to the large size of the families. Infant mortality seems to have a higher incidence than miscarriage. What about penile lesions and scars? We have not observed these in the Bedouins. This lesion is attributed to the "foreign disease" (syphilis) and not to bejel. The Arab is strictly moral within the wide latitude of his polygamous home. One lip chancre was observed on a young man who wished to be assured that it was not "syphilis." Butler and Peterson[15] suggest two explanations for the absence of venereal chancres in the rural population of Haiti. Either (*a*) "the population is so shot through with syphilitic virus that venereal syphilis can rarely find an infectable victim," or (*b*) "the venereal sores are overlooked." They think the first is the correct interpretation in Haiti. We believe it is also the correct interpretation of the similar fact in Deir-ez-Zore.

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[12] Paterson, A. R.: Note on bismuth salt, Arch. Dermat. and Syph., 2, 7, July, 1920.

NOTE.—Kahn series 1: During a period in the spring of 1927 every patient from whom blood could be secured was subjected to the Kahn test. One hundred and fifty-eight different patients passed through the clinic during this period. It was not possible to test every one, and 69 must be thrown out for one reason or another, leaving 89 unselected individuals tested, all adults. These included Christians, Moslem townsmen, and Bedouin Arabs. Forty-three of the 89 returned positive Kahns—i. e., 48 per cent—46, or 52 per cent, were negative. Kahn series 2: The total number of patients tested with the Kahn test in the course of the year was 109. The small number was due to a delay in the shipment of antigen. Of this number, 52, or 48 per cent, were positive, and 57, or 52 per cent, were negative. If we throw out of consideration the Christian refugees who appear in the series, and consider all the remainder together, we find 44, or 52 per cent, positive and 41, or 48 per cent, negative. If we go still further and throw out the Moslem townsmen and consider only the Bedouin nomads and farmers, we find positive Kahns in 22 cases out of 31, or a positive percentage of 72 per cent.

[13] Parsons, R. P.: Bismuto-yatren A and B in the treatment of yaws, U. S. Nav. Med. Bul., 25, *1*, January, 1927, p. 117.

[14] Idem: Treatment of treponematous ulcers with bismuto-yatren, Am. Jour. of Syphilis, July, 1927, p. 425.

[15] Butler and Peterson: Treponematosis as seen in the rural population of Haiti, Jour. of Lab. and Clin. Med., XII, 7, April, 1927, p. 670.

What about nervous and vascular lesions? These seem to be rare No case of general paralysis or tabes dorsalis was observed in the series. The suggestion made elsewhere in the Tropics that the prevalence of malaria may account for the absence of neurosyphilis does not hold in this case, because the Bedouins do not suffer from malaria en masse. Enlarged spleens are rare. A more interesting suggestion is contained in the fact that although the Bedouin suffers all the physical hazards of heat, cold, thirst, hunger, fatigue, etc., he does not seem to suffer any mental strain or worry. There is apparently no nervous wear and tear.[16] But if one accepts the "trauma hypothesis" in regard to the nervous system, then one would expect to find inroads on the vascular-renal systems due to the extreme physical hazards. On the contrary one finds very little nephritis and cardiovascular disease, and no hypertension. In spite of the fact that the Arab's diet is largely protein, because he lives on the products of his flocks, a series of urinalyses on 500 consecutive patients revealed only 7 patients with casts and albumen, and only 3 of these had shown edema. In a consecutive series of blood-pressure estimations made with mercury manometer on 588 adults no case of hypertension was observed. Four hundred and fifteen had systolic readings between 90 and 120 mm. mercury. Only 12 had readings over 150 and none touched 180 mm. With a very few exceptions the diastolic reading was in full normal relation to the systolic, and there was total absence of evidence of aortitis, aortic valvular disease, or aneurysm. These statistics are based on a series of patients both male and female in which 332 out of 1,000 were over 30 years old and 166 were over 40. If syphilis as understood in the west were present to the degree that bejel seems to be present, one would certainly expect to find some of its striking tertiary nervous and vascular conditions in this group of 1,000 patients.

We have mentioned the presence of palatal and nasal erosion and pharyngeal ulceration and scarring which could be called tertiary manifestations of syphilis. However, as this condition under the term of gangosa and rhinopharyngitis mutilans is described in yaws as well as syphilis,[7 8] it does not give us much diagnostic aid. It simply confirms us in the decision to translate the word "bejel" as treponematosis.

A modern lecturer on syphilology called the attention of his class to the importance of the chancre in the development of "resistance" by the organism. He stated that the skin was one of the foremost organs in the formation of "antibody." Stokes [16] calls attention to

[7] Ayuyao, C. D.: Tertiary manifestations of yaws in the larynx, Jour. of P. I. M. A., V, *11*, November, 1925, p. 331.

[8] Idem: Tertiary manifestations of yaws in the nose and throat in the Philippine Islands, Jour. of P. I. M. A., VII, *11*, November, 1927, p. 411.

[16] Stokes, J. H.: Modern Clinical Syphilology, Saunders, Phila., 1926.

the fact that profuse reaction in the skin is rarely followed by severe nervous involvement later. He also says the converse of this seems to be true. He cites experimental evidence in support of the importance of the skin as a factor in the defense mechanism. It is suggestive to lay these facts alongside of the old French name for yaws, viz, *spirochetose cutanée.*[1] Perhaps it was the very fact that this spirochetosis was *cutaneous* that prevented it from being *généralisée*, as true syphilis was designated in contradistinction. Perhaps it is the profuseness of the skin and bone lesions of yaws and bejel which prevent destruction of nervous and vascular tissues in subsequent years of the patient's life.

## DIAGNOSIS

The writer has not felt that in his own mind he could honestly square the disease called bejel with the diagnosis of occidental syphilis, as has been done by others who have described and treated the diseases of the Arabs. A review of the literature of the allied spirochetal disease called frambesia tropica (yaws) also brought no peace of mind. Writers on yaws [1, 6, 17, 18, 19, 20] do not agree on the diagnostic criteria for that disease and there does not seem to be a single character of yaws which can not be duplicated in the literature of syphilis. To illustrate the confusion, Gutierrez [21] names five forms of tertiary lesions found in yaws. These are (*a*) in the skin—tubercles, nodules, and gummata; (*b*) periostitis and osteitis: (*c*) keratoses, notably of the soles; (*d*) gangosa (rhinopharyngitis mutilans, " No doubt a sequel of yaws ") ; (e) nodosites juxta—articulaires (" Not to be differentiated from syphilis clinically "). Goodman,[22] on the other hand, states that in his opinion there is no such period in yaws corresponding to the tertiary period of the syphilitic affection. He says, "As for the gumma lesion of syphilis, it has no counterpart in frambesia." Much of the literature shows confusion in the minds of the writers when they come to the differential diagnoses of the treponematoes. Wood, quoted by Fox,[23] says:

Since studying the question more fully I am inclined to suspect that we have been overlooking yaws and that among the negroes the disease has occurred in

[1] Goodman, Herman: Frambesia tropica (yaws), with bibliography, Proc. Internat. Conf. on Health Probs. in Trop. America, 1924. United Fruit Co.

[6] Gutierrez, P. D.: Yaws, its manifestations and treatment by neoarsphenamine, Arch. Derm. and Syphil., 6, *3*, September, 1922, p. 265.

[17] Gutierrez and Villasenor: The duality of yaws and syphilis, Jour. of the P. I. M. A., VI, *1*, January, 1926, p. 5.

[18] Bell, P.: Yaws (Frambesia) in the Chin Hills, Ind. Ined. Gaz., June, 1925, p. 259.

[19] Jolly, G. G.: Occurrence and distribution of yaws in Burma, Ind. Med. Gaz., December 1926, p. 581.

[20] Schamberg and Klauder: Study of a case of yaws (frambesia tropica) contracted by an American soldier in France. Arch. Dermat. and Syph., *3*, 49, January, 1921.

[21] Gutierrez, P. D.: Late or tertiary manifestations of yaws, Arch. of Derm. and Syphil., 12, October, 1925, p. 465.

[22] Goodman, Herman: Generalized cutaneous syphilis, clinical differentation, III, frambesia tropica and syphilis, Amer. Jour. Syphil., January, 1926, p. 64.

[23] Fox, Howard: The prevalence of yaws in the United States, Arch. of Derm. and Syphil., 6, December, 1922, p. 657.

the South frequently and has been counted as syphilis * * *. Every negro is assumed by most writers to be guilty of syphilis until he proves his innocence. Can it be that syphilis is being generally confounded with yaws in this manner and can it explain the well-recognized mildness of present-day syphilis among the negro?

Pineda and Wade,[9] writing from the Philippine Islands, state:

> It is generally believed that syphilis is not as rampant in our population as it is in many others, and that where present it does not do much harm. Our experience compels us in general to subscribe to this view. At the same time we strongly believe that these very conditions tend to cause syphilis to be unduly ignored.

Fox [23] reports a case of yaws in a negro in New York; Schamberg and Klauder,[20] a young white man with a yaws infection apparently acquired in France; Alderson and Coe,[24] a Filipino with yaws who was studied in California; and Cady and Engman,[25] the case of a negro with yaws who was diagnosed in St. Louis. The composite picture presented by these various cases of frambesia tropica does not have clear definition when the differential diagnosis with syphilis is discussed.

Since bejel seems to select some of its characteristics from syphilis and others from yaws, the only safe ground is the position of Butler et al.[15, 26, 27] in their adoption of the term treponematosis, which would certainly include bejel, as well as syphilis and yaws. If we posit with Butler the existence of two forms of syphilis, the epidemic and the venereal, we must grant the possibility of all shades between these, depending on the progress of the community away from the "stone age," and toward the environment of "treatment, clothing, and shoes." Bejel is presented as a spirochetal disease due to *Treponema pallidum*, a variant of the "Syphilis-yaws" treponematosis. Clinical and serological studies of this disease are being continued.

## Public Health Aspect

If we are dealing in Deir-ez-Zore with an epidemic type of treponematosis among the Arabs, it is evident from the experience of Butler and others in the public-health work in Haiti, and of Lopez-

[9] Pineda and Wade: The public health value of the Kahn precip. test, with special reference to yaws, Jour. of the P. I. M. A., VI, 6, June, 1926.

[15] Butler and Peterson: Treponematosis as seen in the rural population of Haiti, Jour. of Lab. and Clin. Med., XII, 7, April, 1927, p. 670.

[20] Schamberg and Klauder: Study of a case of yaws (frambesia tropica) contracted by an American soldier in France, Arch. Dermat. and Syph., 3, 49, January, 1921.

[23] Fox, Howard: The prevalence of yaws in the United States, Arch. of Derm. and Syphil., 6, December, 1922, p. 657.

[24] Alderson and Coe: Report of a case of yaws in California, Calif. State Jour. of Med., April, 1923.

[25] Cady and Engman: A case of yaws occurring in Missouri, Arch. of Derm. and Syphil., 10, October, 1924, p. 446.

[26] Butler and Peterson: Treponematosis as a public health factor; Amer. Jour. of Syphil., 11, October, 1927, 539.

[27] Butler and Parsons: Effects of mass treatment on the epidemiology of treponematosis; Amer. Jour. of Syphil., April, 1927, p. 228.

Rizal and others in the Philippines, that intermittent and individual treatment of the disease is worthless, and that an adequate attack of the disease must be a public-health function, treatment to be carried on widely and intensively and with persistent vigilance. The respective governments upon which this responsibility would largely devolve are the British and French through their mandatory relation to the governments of Palestine, Iraq, and Syria. The facts presented above in regard to the comparatively small area about Deir-ez-Zore suggest studies of a wider field. It is not unlikely that the prevalence of treponematosis in Deir-ez-Zore is characteristic of the Bedouin Arabs wherever found.

New compounds of bismuth which seem to have great spirocheticidal power and which can be administered intramuscularly offer the hope that an adequate campaign can now be carried on much more cheaply and easily than was thought possible when intravenous neosalvarsan was considered necessary.

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## TULAREMIA (FRANCIS'S DISEASE)

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It has been quite generally considered that tularemia is a relatively rare disease of man and that it is of importance chiefly in those States west of the Mississippi River. The fact that the writer has been able to unearth 53 confirmed cases of tularemia in Dayton, Ohio, since last November would seem to prove quite conclusively that tularemia is a common disease of man and that it is by no means a disease chiefly confined to the western States. It was also demonstrated that tularemia has existed in Dayton for at least 20 years. Detailed descriptions of the Dayton cases have appeared elsewhere (1).

The increasing importance of this disease is indicated by the fact that during the past four years Francis has recorded over 600 (2) confirmed cases. Prior to 1924, but 15 cases had been reported. Thanks to the writings of Francis, American physicians have acquired the ability to recognize this disease.

With the exception of seven cases from Japan and three cases which occurred among laboratorians at London, England, all of the recorded cases have occurred within the boundaries of the United States. Cases have been reported from every State in the Union except the New England States, Delaware, Wisconsin, and Washington. The greatest number of cases, 77, has been reported from Ohio. Montana ranks second with 59 cases. (Fig. 1.)

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[1] EDITOR'S NOTE.—At the Minneapolis session of the American Medical Association, 1928, Doctor Simpson's exhibit of tularemia received the highest award, a gold medal.

In every respect, tularemia has been "made in America." Its specific etiologic agent, the modes of transmission from animal to animal and from animal to man, and the accurate descriptions of its pathological, bacteriological, serological, and clinical characteristics, have been made known by American investigators. In these respects, tularemia occupies an unique position in medical history.

On September 19, 1907, Ancil Martin, an ophthalmic surgeon of the then Territory of Arizona, sent a letter to F. G. Novy, professor of Bacteriology at the University of Michigan, in which he described several cases of a disease of humans which he attributed to an infection resulting from the skinning and dressing of wild jack rabbits. He described briefly and accurately the essential characteristics of the disease now known as tularemia, and this letter stands as the first written record of the clinical manifestations of the disease. Francis

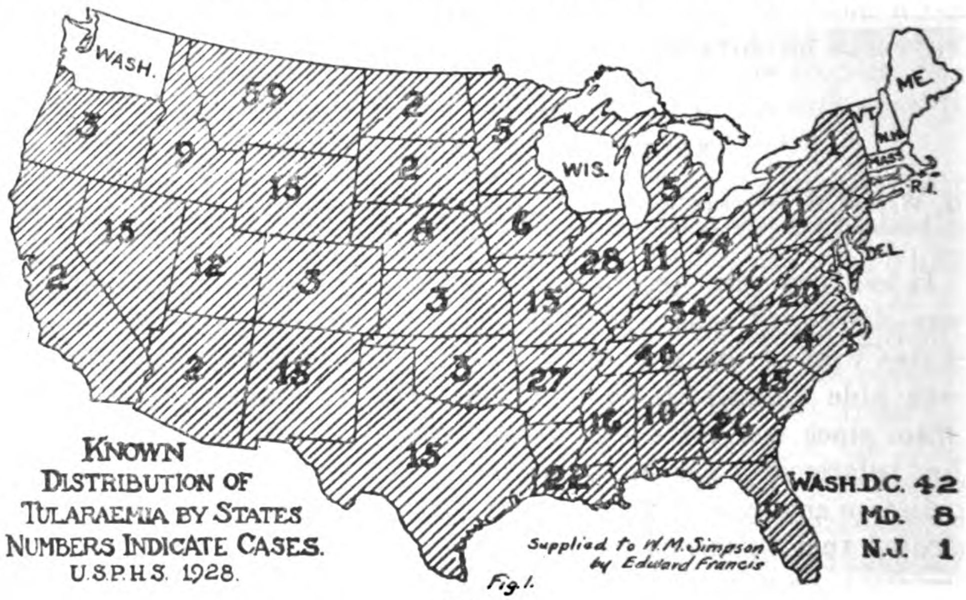


FIG. 1

found anti-*tularense* agglutinins in the serum of one of Martin's patients 18 years after the original infection.

Three years later, Pearse (3), of Brigham City, Utah, described nine cases of a disease of man which had been popularly known among ranchers for many years as "deer fly fever." To Pearse should go the credit for having first published his observations of the clinical manifestations of the disease which was to be called *tularemia* by Francis nine years later. In all of Pearse's cases the disease followed deer fly bites.

While engaged in an investigation of a "plague-like" epizoötic occurring among ground squirrels in Tulare County, Calif., in 1911, McCoy and Chapin (4), of the United States Public Health Service, isolated a new organism which they named *Bacterium tularense* after the county in which their discovery was made.

Between 1914 and 1917, Vail (5), Sattler (6), and Lamb (7), all ophthalmologists of Cincinnati, Ohio, described cases of *Bacterium tularense* infection of the eye. *Bacterium tularense* was isolated by Wherry and Lamb (8) in all three cases. These were the first instances of the recognition of the disease of man *bacteriologically*.

It remained for Edward Francis (9), of the United States Public Health Service, to point out that the disease known as deer-fly fever was caused by the same organism which was responsible for the plaguelike disease of rodents described by McCoy and Chapin. While investigating the so-called deer-fly fever in Utah, Francis isolated *Bacterium tularense* from seven humans, one of whom died of the infection and all of whom had been bitten by the deer fly, *Chrysops discalis* Williston. Francis named this new disease of man *tularemia* (10). During the course of this investigation Francis and his assistant, Mayne, acquired the disease. Francis turned their misfortune to good account by demonstrating in their sera anti-*tularense* agglutinins. Francis also demonstrated that the disease could be transmitted among laboratory animals by the deer fly (11).

In 1924, Parker and Spencer (12), of the United States Public Health Service, while investigating Rocky Mountain spotted fever in the Bitterroot Valley of Montana, discovered that the common-wood tick of that region, *Dermacentor andersoni* Stiles, was a host and transmitter of tularemia. They also demonstrated hereditary transmission of the infection by female ticks through their eggs from generation to generation (13). During the course of this investigation Parker and Spencer (14) and four other laboratorians acquired the disease and in three instances the direct cause was the handling of infected ticks.

Hachiro Ohara, a Japanese investigator, published a report " concerning an acute febrile disease transmitted by wild rabbits " in 1925. During that year four articles appeared in Japanese literature describing this disease, but in these no reference was made to tularemia. Two of the Japanese investigators acquired the disease after performing autopsies on infected laboratory animals. Francis and Moore (15) proved conclusively that Ohara's disease and tularemia are identical.

In 1925, Dieter and Rhodes (16) discovered that tularemia existed among wild rats which had been trapped in Los Angeles, Calif. In 1927 Perry (17) isolated *Bacterium tularense* after guinea pig inoculation from two wild meadow mice in Contra Costa County, Calif. More recently, Green and Wade (18) have reproduced tularemia experimentally in certain birds. While these findings possess considerable scientific interest they are of very little clinical importance because it is the wild rabbit which constitutes the great reservoir of infection.

While the deer fly and the wood tick are important intermediate transmitters of the disease in the Northwest, neither of these "carriers" is an important transmitter of the disease east of the Mississippi, although a tick of undetermined species has transmitted the disease in Louisiana, Oklahoma, Tennessee, Texas, and Arkansas. Every case in the Dayton series resulted from direct self-inoculation as a result of handling infected rabbit tissues. Most of the cases have occurred among market men who have skinned and dressed wild rabbits; in housewives or servants who have dressed rabbits for the table; in hunters who have dressed rabbits during the hunt; in farmers or ranchers who have picked infected ticks or flies from their horses or cattle, or who have cut up rabbits for fish bait, coyote bait, or for food for domestic animals. Twenty cases have occurred among laboratory workers as a result of handling infected laboratory animals or infected ticks. No disease has ever claimed so many victims among laboratorians as has tularemia.

There is no recorded instance of man-to-man infection either as the result of direct contact or by the bite of infected deer flies which have previously bitten a tularemic patient. Freese, Lake, and Francis (19) presented some experimental evidence, however, which would indicate that insufficiently cooked rabbit meat might be dangerous as food. After cooking a laboratory rabbit dead of tularemia, they dissected the muscles and found some red tissue juice and red fibers near the bones. Guinea pigs inoculated with this insufficiently cooked muscle died acutely of tularemia. The organism is relatively thermolabile. It succumbs to a temperature of 56° to 58° C. in 10 minutes in cultures and in splenic tissue.

The disease is transmitted from rodent to rodent in nature through the agency of blood sucking lice, flies, and ticks. The disease does not exist in nature among domestic rabbits, although such animals are very susceptible to experimental inoculation.

## Clinical Manifestations

There is remarkable seasonable variation in the incidence of the disease east and west of the Mississippi River. In the northwestern States most of the cases occur during the season of the greatest activity of the wood ticks (March to August) and the deer flies (June to September). Furthermore, jack rabbits are found almost exclusively west of the Mississippi, and, since they are considered a pest, they are hunted from April to October, and human cases resulting from contact with jack rabbits occur during that period. East of the Mississippi, however, the incidence of the disease conforms with that period of the year when the State game laws permit the hunting of the wild cottontail rabbits (November, December,

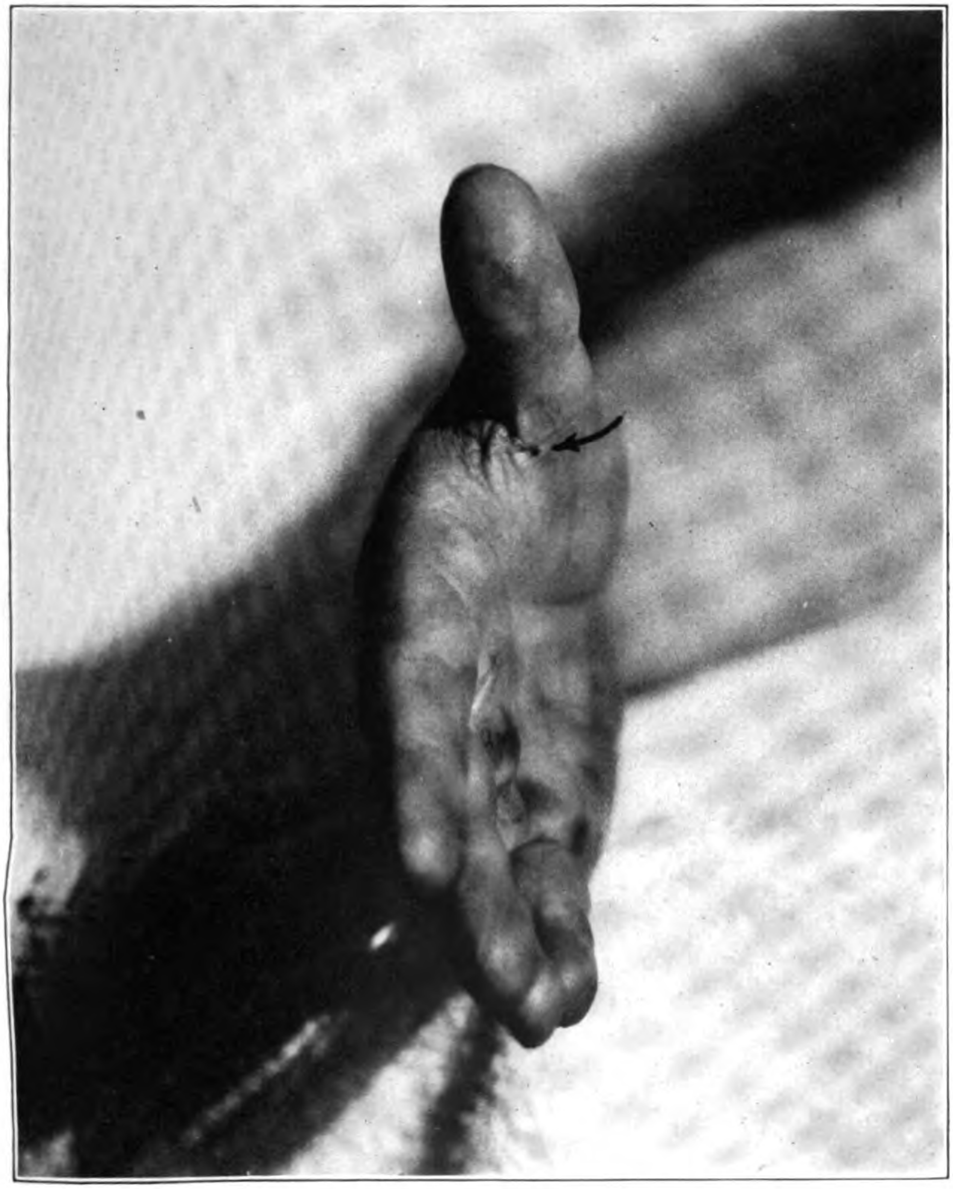

FIG. 2.—MR. C. D. M. SMALL PRIMARY ULCER IN WEB BETWEEN RIGHT THUMB AND INDEX FINGER; EIGHT WEEKS AFTER ONSET

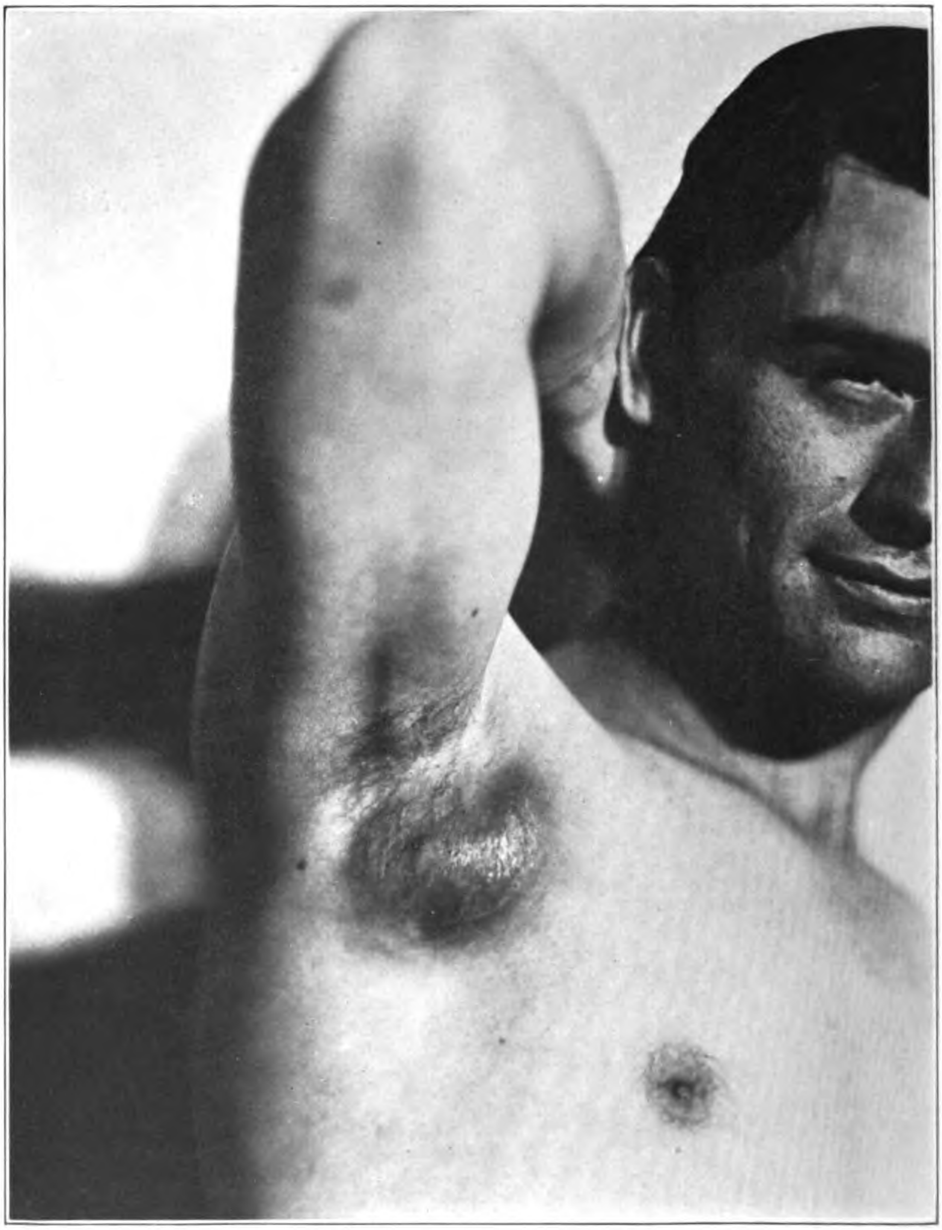

FIG. 3.—MR. C. D. M. MASSIVE SUPPURATING RIGHT AXILLARY ADENOPATHY. SPONTANEOUS EVACUATION OCCURRED TWO DAYS AFTER PHOTOGRAPH WAS TAKEN; EIGHT WEEKS AFTER ONSET



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FIG. 4.—MR. J. S. HEALING PRIMARY LESION NEAR NAILBED OF LEFT THUMB; SIX WEEKS AFTER PERFORATING WOUND PRODUCED BY SHARP SPICULE OF RABBIT BONE

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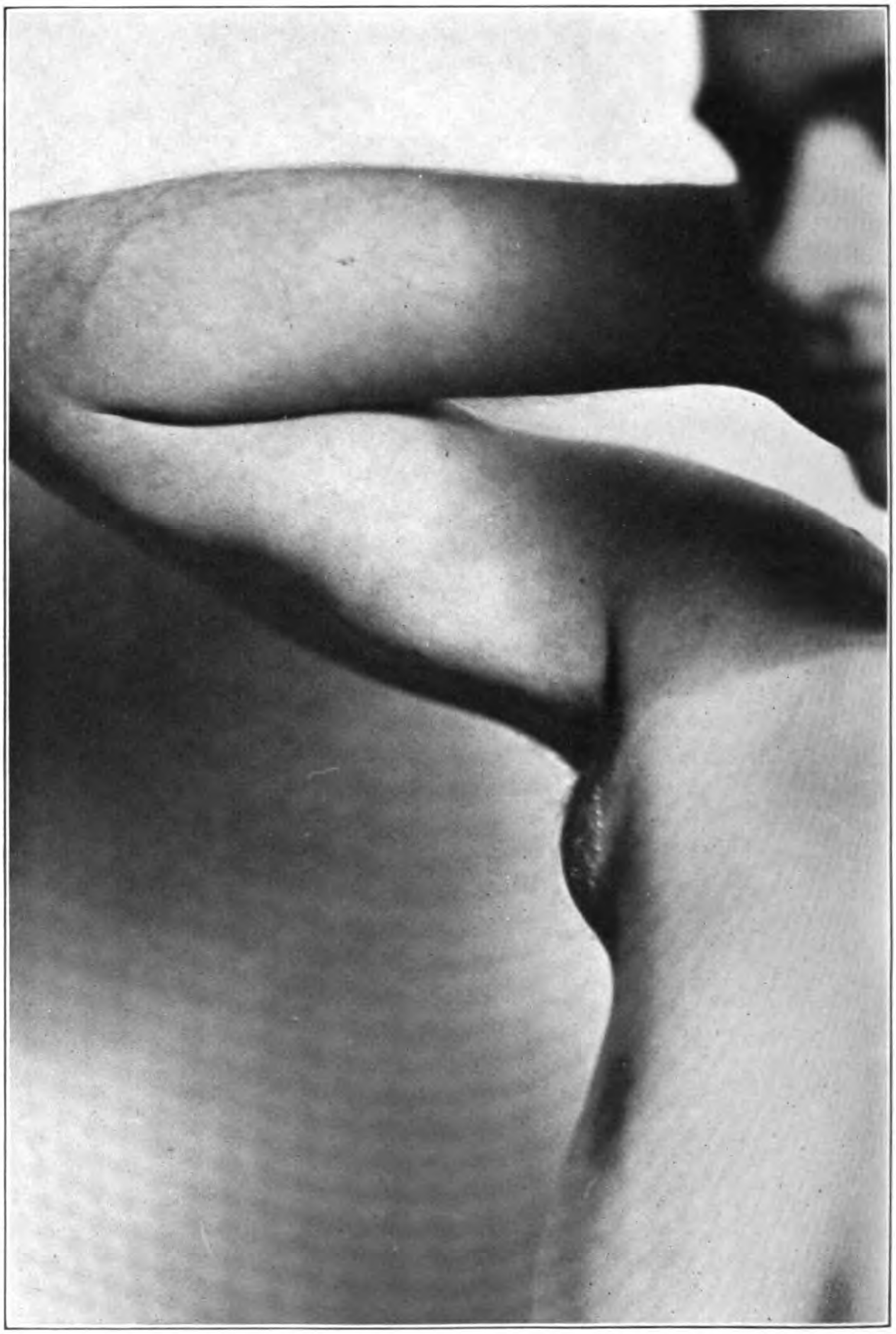

FIG. 5.—MR. J. S. AXILLARY ADENOPATHY; SIX WEEKS AFTER ONSET. PURULENT INFILTRATION OF OVERLYING SKIN

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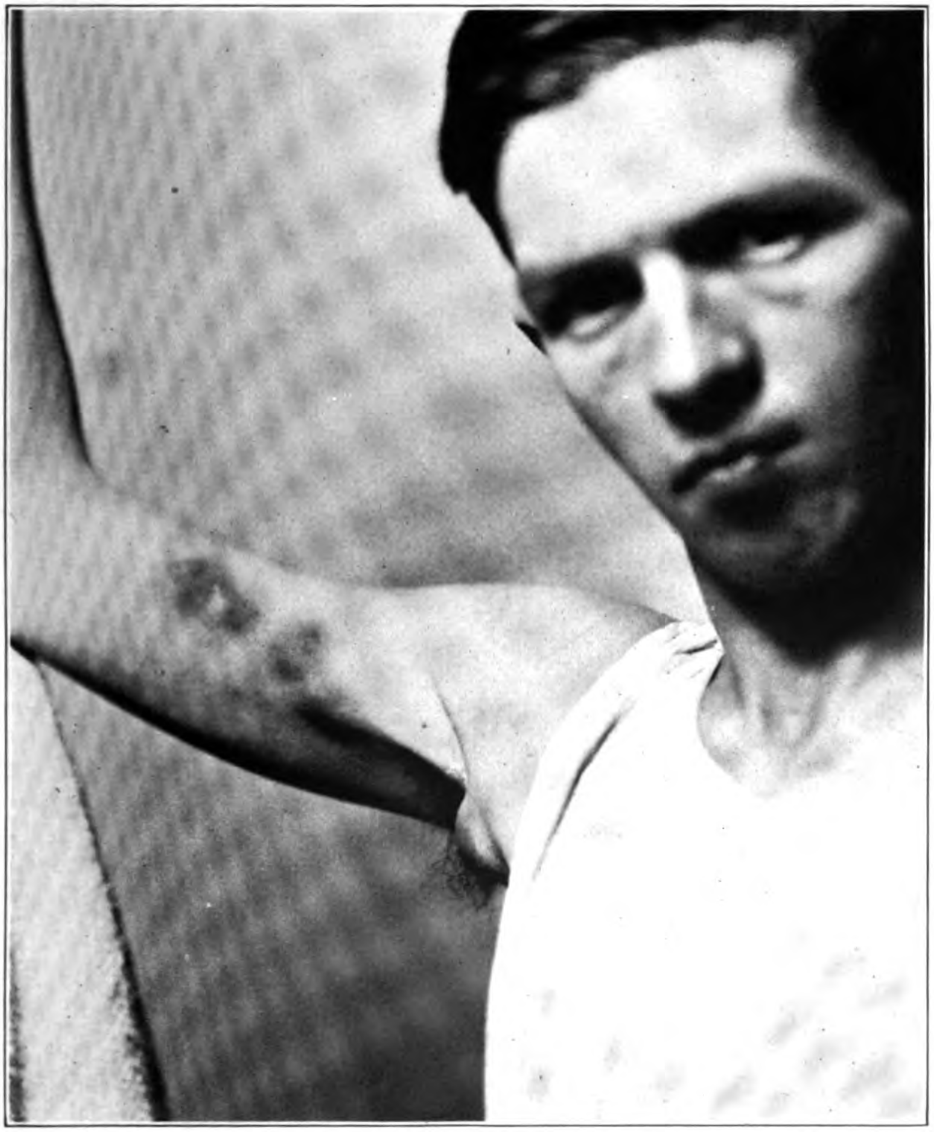

FIG. 6.—MR. H. C. SPOROTRICHOSIS-LIKE NODULAR LYMPHANGITIS OF ARM, WITH SUPPURATING AXILLARY ADENITIS; SIX WEEKS AFTER ONSET

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and January). In the Dayton series every case of the disease was acquired during November.

The period of incubation varies from one to six days. In the majority of the cases the acute onset of illness occurs on the third or fourth day after inoculation. The onset is sudden and is usually initiated with a sharp chill which may occur while the patient is asleep or while he is in the midst of his work. The onset symptoms simulate those of a severe influenzal infection: Fever, which frequently rises to 104° to 105° F., chills and sweats, severe headache, aching pains in the back and extremities, marked prostration, and, frequently, vomiting and diarrhea. Delirium is common during the acute stage of the illness.

An analysis of over 600 case reports indicates that there are four distinct clinical types of this disease:

1. *Ulceroglandular type.*—This is the most common and important form of the disease. Over two-thirds of the recorded cases fall into this group. The primary lesion begins as a papule which develops at the point of inoculation, usually on the finger or hand in the cases acquired by direct contact. The center of the papule undergoes necrosis and the necrotic core is liberated, leaving an ulcer, usually about three-eighths inch in diameter, with reddish elevated periphery, a necrotic base, and a sharply punched-out border. The patient usually complains, within a day of the onset of illness, of painful swellings in those lymph nodes which drain the site of the inoculation. The primary ulcer heals very slowly and healing is apt to be greatly delayed if the primary lesion is lanced. The primary lesion is a granuloma and incision is of no benefit.

In about one-half of the ulcerglandular cases the enlarged and painful regional lymph nodes will suppurate, and in these cases we have found that the convalescence is shortened by surgical drainage after fluctuation develops. In the other half of the cases the lymph glands do not suppurate but remain firm and gradually regress in size over a period of several months.

Sporotrichosis-like nodular lymphangitis along the lymphatics of the forearm and arm occurred in 9 of our cases and in 33 of the previously reported cases. In many instances these nodules suppurated and either drained spontaneously or were incised.

In the majority of the Dayton cases inoculation occurred as a result of a perforating wound produced by a sharp fragment of rabbit bone.

2. *Oculoglandular type.*—In this form the primary localization is in the conjunctiva, and is usually the result of inadvertently wiping the eye with contaminated fingers. Along with the conjunctivitis

there occur painful enlargements of one or more of the following groups of regional lymph nodes: Preauricular, parotid, postauricular, submaxillary, anterior cervical, and in a few severe cases the axillary group. The same severe constitutional symptoms occur as in the ulceroglandular type. The diseases known to ophthamologists as Parinaud's conjunctivitis and *conjunctivitis necroticans infectiosa* are clinically similar to conjunctivitis tularensis, and many of the cases reported under these names may be in fact examples of conjunctivitis tularensis.

3. *Glandular type.*—In this form of the disease there is no demonstrable primary lesion. In nine of the Dayton cases careful scrutiny revealed no visible primary lesion. In all other respects the disease is similar to the ulceroglandular type. There is both clinical and experimental proof of the ability of the organism to penetrate unbroken skin.

4. *Typhoid type.*—This rare form of the disease constitutes the greatest diagnostic problem. There is no primary lesion and no adenopathy. Fever is the outstanding symptom, and in many cases it simulates typhoid fever. The diagnosis is established serologically. Most of the cases occurring among laboratorians were of this type.

A skin eruption occurs occasionally. It may be macular, papular, pustular, or any combination of these lesions. Many of those individuals who have developed a pustular eruption have died. The eruptions may involve any part of the body.

The convalescence is one of the worst features of the disease because of its prolonged character. In most instances the patient is confined to bed for two or three weeks. During the second month a feeling of great fatigue prevents the individual from exerting himself. Many have tried to undertake their usual work during the third or fourth month and have been forced to quit and rest for another month or two. Many have not regained their strength for over one year. Ultimate recovery usually occurs without sequelæ. One attack of tularemia confers permanent immunity.

Francis has recorded 23 deaths (4 per cent). The writer is of the opinion that this proportion of deaths does not adequately represent the true death rate, since he has learned of seven deaths which have occurred during the last 10 years in Dayton, all probably due to this disease. In one of the Dayton cases death occurred four days and seven hours after the onset of illness. The organism was recovered after animal passage by Francis and by the writer from serum collected the day before death. Autopsy revealed the characteristic lymph node and visceral lesions and the organism was again recovered from axillary tissue taken at the time of autopsy.

### Diagnosis

The most important factor in the diagnosis of tularemia is to have the disease in mind. Its symptoms and signs are so characteristic in most instances that it is not easily confused with any other disease. The important considerations are the history of contact with rabbits or deer flies or wood ticks, the development of the indolent primary lesion and the regional adenopathy, associated with the "grippelike" onset symptoms.

Many cases have been primarily diagnosed influenza. The next most common error has been to consider the disease as one of streptococcus etiology. Many have insisted upon the diagnosis of typhoid fever until compelled to relinquish this diagnosis because of repeated negative Widal reactions and positive agglutination of *Bacterium tularense.* The development of nodular lymphangitis in some cases has lead to the diagnosis of sporotrichosis. Because of the fact that the serum in tularemia occasionally cross-agglutinates *Bacterium melitense* and *Bacterium abortum*, serologists have confused the disease with undulant fever. Even though a close serological relationship seems to exist between *Bacterium tularense*, *Bacterium melitense*, and *Bacterium abortum* in occasional cases, the proportionately higher titre reached by anti-*tularense* agglutinins and the use of reciprocal agglutinin absorption tests leave no doubt as to the diagnosis. Because of the similarity of the granulomatous lesions in tissue sections, pathologists have clung to the diagnosis of tuberculosis.

It is an easy matter to confirm the clinical diagnosis. The best method is to collect 4 or 5 cubic centimeters of blood, exactly as one collects it for the Wassermann test. This may be submitted to the Hygienic Laboratory of the United States Public Health Service at Washington or to any laboratory that possesses the necessary *Bacterium tularense* antigen for agglutination reactions. One of the remarkable characteristics of this disease is the persistence of the agglutinins. Anti-*tularense* agglutinins have never entirely disappeared from any case. It is, therefore, possible to take the serum of a patient suspected of having had tularemia many years previously and still determine accurately whether or not that patient has ever had tularemia. In one of the Dayton cases agglutinins were present in relatively high titre (1:160) 19 years and 4 months after the original infection. Agglutinins are constantly present at some time during the second week of illness. It is useless to take blood for agglutination reactions during the first week. An abrupt rise in titre occurs during the third week, reaching its maximum (1:1,280 to 1:2,560) during the fourth to the seventh week, after which there

is a gradual decline in titre until, at the end of the first year, the average titre is about 1:160.

A second method for confirming the clinical diagnosis is to isolate the organism from guinea pigs inoculated with the blood of the patient or with material from the primary lesion or from the regional lymph nodes. It has been repeatedly stated that all attempts to recover the organism directly from human tissues on artificial culture media have been futile. Using a cystine-glucose-peptone-meat infusion agar (Francis's medium), to which 5 per cent human serum had been added, the writer succeeded in two instances in growing the organism directly from the material taken from the walls of axillary abscesses. The organism will not grow on ordinary laboratory media. It grows well on coagulated egg yolk and cystine agar. Cover glass preparations made directly from the pus evacuated at the time of surgical drainage are of no value in determining the identity of the organism.

## Treatment

There is no specific treatment. The treatment is essentially symptomatic. Strict confinement to bed is the most important measure. It is unwise to incise the primary lesion, and the enlarged regional lymph nodes should not be surgically drained until definite suppuration is present. No intravenous therapy (mercurochrome and other dyes, iodides, etc.) has altered the course of the disease. Prophylactic measures are of great importance. These include the education of market men and the laity in general as to the dangers of the infection and the manner in which it is acquired, by urging thorough cooking and by the warning that all individuals who handle wild rabbits or infected laboratory animals should wear rubber gloves. The writer is now engaged in an investigation of the effect of immune serum on the course of the disease and this will be made the subject of a further report.

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## PHYSIOLOGY OF RESPIRATION IN RELATIONSHIP TO THE PROBLEMS OF NAVAL MEDICINE[1]

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### Part IV

### HIGH ALTITUDES

The phenomena of oxygen want are most clearly seen in men at high altitudes, but the same symptoms may occur in a wide variety of conditions where the relationship to a deficiency of oxygen is

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much less apparent. Most writers use the term "anoxemia" as synonymous with oxygen want, but this is not quite correct, and we must remember that oxygen want may occur even when there is a plentiful supply of oxygen in the blood. Barcroft classifies the chronic types of anoxemia as the anoxic, anemic, and stagnant. In the anoxic type, such as occurs at high altitudes, the pressure of oxygen in the blood is too low. In the anemic type, as, for example, carbon-monoxide poisoning, the quantity of normal hemoglobin is too small. The stagnant type is best illustrated by heart failure where an insufficient supply of oxygen is supplied to the tissues. Meakins and Davies (1) give a more comprehensive classification, which may be abbreviated as follows:

(*a*) Insufficient partial pressure of oxygen in the inspired air:

1. Mountain sickness, balloon ascents, etc., where the oxygen percentage remains normal but the barometric pressure is greatly reduced.

2. "Black damp" or "fire damp" in mines, where the barometric pressure is normal or even increased while the oxygen percentage is markedly diminished. (This type of diminution may occur in submarines but is usually complicated by increased carbon dioxide.)

(*b*) Obstruction to the air passages, preventing free entrance and exit to the lung alveoli.

(*c*) Obstruction to the passage of oxygen from the alveolar air to the pulmonary blood; e. g., edema of the lungs or emphysema.

(*d*) Alteration in the oxygen-carrying capacity of the blood; e. g., anemia, carbon monoxide poisoning.

(*e*) Conditions where the blood leaving the lungs is fully oxygenated but the tissues are not properly supplied with oxygen; e. g., circulatory failure.

(*f*) Conditions where the mixed arterial blood through admixture with venous blood is deficient in oxygen; e. g., unequal ventilation of the lungs such as occurs in lobar pneumonia. Congenital heart disease.

(*g*) Conditions where the tissues are well supplied with oxygen but, on account of the action of certain protoplasmic poisons, are unable to utilize it; e. g., cyanide poisoning.

In all of these conditions we find that oxygen want is the fundamental cause of the trouble. The symptoms depend on the rapidity of the production of the anoxemia, its degree, duration, the nature of the tissues chiefly affected, and the resistance or powers of adaptation of the individual.

Man has but a small store of reserve oxygen. Henderson and Haggard (2) estimate that during ordinary breathing the lungs contain 0.56 liter of oxygen and the blood only enough more to bring the total to 0.9 liter, or barely five minutes' supply even for resting

conditions. After this is exhausted complete anoxemia results, which in the course of about 10 minutes leads to irreparable damage to the nervous system.

A man can hold his breath for one or two minutes while he is using the reserve supply of oxygen in his lungs. If, however, he takes a few breaths of some inert gas such as pure nitrogen or hydrogen he washes out this reserve of oxygen in a few seconds and falls unconscious. Rapid death may result from a breath or two of cyanide which renders the tissues incapable of receiving or utilizing oxygen. Such examples illustrate the results of sudden oxygen want, fortunately encountered but seldom.

The various stages of anoxemia have been well described by Henderson and Haggard (2) in their excellent monograph on noxious gases. They call attention to the fact that even in mild but uniformly maintained asphyxia the symptoms become increasingly severe as the nervous system is damaged more and more by the duration of the anoxemia. I shall quote them verbatim:

*First stage of anoxemia.*—When the oxygen of the inspired air is diminished from the normal 21 per cent, about 160 millimeters, to values between 16 and 12 per cent—that is, somewhat beyond the point at which a candle is extinguished—the first perceptible signs of anoxemia develop. The volume of breathing is increased and the pulse rate is accelerated. (Both of these conditions actually begin earlier, but not noticeably.) The ability to maintain attention and to think clearly is diminished but can be restored with effort. Muscular coordination for the finer skilled movements, such as writing, is somewhat disturbed. Respiration is much increased, so that the amount of carbon dioxide in the body is correspondingly decreased.

*Second stage of anoxemia.*—When the oxygen is diminished to values between 14 and 9 per cent the higher centers of the brain are affected. Consciousness continues but the judgment becomes faulty. Severe injuries such as burns, bruises, and even broken bones may cause no pain. Emotions, particularly ill temper and pugnacity, and less often hilarity, or an alternation of moods, are aroused with abnormal readiness. Muscular efforts lead to rapid fatigue, and may permanently injure the heart. As they intensify the anoxemia, they may induce fainting. The respiration is frequently of the intermittent or Cheyne-Stokes type.

*Third stage of anoxemia.*—When the oxygen is diminished to values between 10 and 6 per cent, nausea and vomiting may appear. The subject loses the ability to perform any vigorous muscular movement. Bewilderment and loss of consciousness follow, either with fainting, or in rigid glassy-eyed coma. If revived, the subject may have no recollection of this stage or an entirely erroneous belief as to what has happened.

Up to this stage, or even in it, he may be wholly unaware that anything is wrong. Then his legs give way, leaving him unable to stand or walk. This is often the first and only warning, and it comes too late. He may realize that he is dying, but he does not greatly care. It is all quite painless.

*Fourth stage of anoxemia.*—When the oxygen is diminished below 6 per cent, respiration consists of gasps. Convulsive movements may occur. Then the breathing stops, but the heart continues to beat for 6 to 8 minutes. Then death.

This description might well be a specific account of a man undergoing the test for aviators in a low pressure chamber or on a rebreathing apparatus. On careful analysis, however, you will find that it applies equally well to miners exposed to black damp (nitrogen) or to patients suffering from carbon monoxide poisoning. We have already come across most of these symptoms in our discussions of severe pneumonia, cardiac failure, and submarine disasters.

### Anoxemia at High Altitudes

The foundations of our knowledge of the physiological effects of high altitudes were firmly laid as early as 1878 by Paul Bert (3) in his classical book La Pression Barométrique. It was he who first grasped the significant fact that the partial pressure of oxygen counted, not the percentage alone or the barometric pressure alone but the product of these two. By means of bell jars for animals and two steel chambers in which a man could be placed under reduced pressure, he duplicated all the phenomena observed on high mountains or in balloons and proved that all the symptoms could be relieved by breathing oxygen.

Haldane (4) in his book on respiration has given a most entertaining account of Paul Bert and the early balloonists. In 1783 the brothers Montgolfier first used hot-air balloons and soon afterwards the French physicist, Charles, invented the hydrogen balloon and with it reached an altitude of 13,000 feet. In 1804 Robertson attained 26,000 feet and suffered severe symptoms. Glaisher and Coxwell, in 1862, rose to a height estimated at 29,000 feet and Glaisher lost consciousness. Coxwell tried to pull the valve rope and found his arms paralyzed, but had the presence of mind to use his teeth. The most famous ascent was that of the French scientists, Crocé-Spinnelli, Sivel, and Tissandier, in 1875. The two former died from oxygen want, but Tissandier has left the following graphic account which Meakins and Davies (1) have translated from Paul Bert's book:

> I now come to the fateful moments when we were overcome by the terrible action of reduced pressure. At 7,000 meters (320 mm.) we were all below in the car—torpor had seized me. My hands were cold and I wished to put on my fur gloves; but, without being aware of it, the action of taking them from my pocket required an effort which I was unable to make. At this height I wrote, nevertheless, in my notebook almost mechanically, and reproduce literally the following words, though I have no very clear recollection of writing them. They were written very illegibly by a hand rendered very shaky by the cold: "*My hands are frozen. I am well. We are well. Haze on the horizon with small rounded cirrus. We are rising. Crocé is panting. We breathe oxygen. Sivel shuts his eyes; Crocé also shuts his eyes. I empty aspirator. 1.20 p. m., —11°, B. 320. Sivel is dozing. 1.25, —11°, B. 300. Sivel throws ballast*" (the last words scarcely legible). I had taken care to keep absolutely

still, without suspecting that I had, already, lost the use of my limbs. At about 7,500 meters (300 mm.) the condition of torpor which comes over one is extraordinary. Body and mind become feebler little by little, gradually and insensibly. There is no suffering. On the contrary, one feels an inward joy. There is no thought of the dangerous position; one rises and is glad to be rising. The vertigo of high altitudes is not an empty word; but so far as I can judge from my own impressions this vertigo appears at the last moment and immediately precedes extinction, sudden, unexpected, and irresistible. I soon felt myself so weak that I could not even turn my head to look at my companions. I wished to take hold of the oxygen tube, but found that I could not move my arms. My mind was still clear, however, and I watched the aneroid with my eyes fixed on the needle, which soon pointed to 290 millimeters and then to 280. I wished to call out that we were now at 8,000 meters, but my tongue was paralyzed. All at once I shut my eyes and fell down powerless and lost all further memory. It was about 1.30.

In this ascent the balloon continued to rise till a minimum pressure of 263 millimeters, registered automatically, was reached. When Tissandier recovered consciousness Sivel and Crocé-Spinelli were dead. They were all provided with oxygen, ready to breathe, but all were paralyzed before they realized the need for it.

In 1901 Berson and Süring, using oxygen cylinders, reached about 36,000 feet in a balloon. In 1920 Major Schroeder, of the United States Army Air Service, established a record of 33,114 feet in an airplane, but became unconscious and had a narrow escape. Lieutenant Champion, of the United States Navy, in 1927 slightly exceeded this height in a hydroplane, when his machine caught fire and he was obliged to fight the flames as he made a forced landing.

Many scientific expeditions have been made to high mountains to observe the effects of altitude. Two of the most recent and most important were the Anglo-American expedition to Pike's Peak (14,110 feet) by Douglas, Haldane, Henderson, and Schneider, and a similar expedition to Cerro de Pasco (14,200 feet) in the Peruvian Andes, in which Barcroft, Meakins, and several American physiologists made extensive studies of the permanent residents. In addition, many important facts have been demonstrated at sea level in low-pressure chambers by Haldane, Henderson, Schneider, and others.

The symptoms of mountain sickness can be observed most easily at Pike's Peak, where tourists who have been partially acclimatized near the foot of the mountain at an altitude of 6,000 feet take the train to the summit of the Peak where the altitude is 14,110 feet and the barometer 453 millimeters. Some individuals, especially those in good physical training, show no untoward symptoms on some ascents though they may be affected at another time. Most, however, look blue and pant on exertion. Many are nauseated and some of these faint. Oxygen relieves these symptoms. As might be expected, the tourists who walk up the mountain suffer more than those who ride on the train.

If the mountain sickness is not too severe and if the man remains in the hotel on the mountain he becomes acclimatized in the course of a few days. He now finds himself able to indulge in mountain climbing, although he is never capable of quite as strenuous exertion as if he were at sea level.

The Andean expedition found in the mines at Cerro (14,200 feet) white engineers who had lived at this altitude many months or years and native laborers who had been born there. These Indians were capable of carrying heavy loads of ore up steep ladders. This furnished the scientists an unusual opportunity of studying the processes of adaptation.

The basal metabolism of acclimatized men at altitudes of 14,000 feet is practically the same as at sea level. Schneider, Truesdell, and Clarke (5), using a steel chamber, found a reduction of 4.5 to 26 per cent in most of their subjects when the barometric pressure was reduced to between 410–310 millimeters mercury for 30 to 60 minutes. Later there was a return to normal and in some instances a rise which was probably due to mountain sickness. Thus we see that under ordinary resting conditions on mountains there is no increased consumption of oxygen and even muscular exercise does not involve any greater demands from the tissues than at sea level. The chief physiological problem is how to supply the tissues with the normal quantity of oxygen. There is no difficulty in the removal of carbon dioxide; in fact, everything tends to aid its removal.

The most outstanding phenomenon is the increase in the rate and depth of respiration. Schneider (6) gives the following figures for one man on whom he measured the amount of air entering the lungs per minute:

| Respiration | Rate | | Minute volume | |
|---|---|---|---|---|
| | At sea level | On Pikes Peak | At sea level | On Pikes Peak |
| Standing | 17 | 20 | 10.4 | 14.9 |
| Walking at 4 miles per hour | 17.2 | 29 | 37.3 | 57.0 |
| Walking at 5 miles per hour | 20 | 36 | 60.9 | 110.2 |

This increase in respiration seems to be due to a stimulation of the respiratory center caused by a lack of oxygen. We have seen in the previous chapter that the most important regulator of respiration is the $P_H$ of the blood; acids, especially carbon dioxide, stimulating the respiratory center. Oxygen want in the respiratory center is a secondary stimulus, acting as a rule more slowly. Perhaps the effect of anoxemia on the center is to permit the accumulation of lactic acid or other products of the metabolism of the center itself.

The natural result of an increased ventilation of the lungs is to raise the percentage of oxygen in the alveolar air and to lower the percentage of carbon dioxide. Of course the partial pressure, expressed in terms of millimeters of mercury, of both of these gases is diminished on Pike's Peak, because the total barometric pressure is about 60 per cent of that at sea level. Schneider (6), describing the results on his companions, says that the average $CO_2$ tension of the alveolar air on arrival at the summit of the peak was 32.8 millimeters, falling later to between 25.4 and 29.5 millimeters. The oxygen on arrival ranged between 40.2 and 47.1, rising to 54–56.4 millimeters as the $CO_2$ fell. Had the sea level $CO_2$ tension of 40 millimeters been maintained at 14,000 feet the alveolar $O_2$ tension would have been only 36.

There is a distinct lowering of the $CO_2$ content of the arterial blood and a shift of the $CO_2$ dissociation curve to the right. Tests of the blood of some of the men on the Andean Expedition indicated a slight change of the $P_H$ in the direction of increased alkalinity, showing a partly compensated gaseous alkalosis. The body responds to this by diminishing the ammonia formation and increasing the excretion of alkali by the kidneys. The compensation at high altitudes is never quite complete and a slight alkalosis remains. Barcroft and his associates in the Andes found a shift of the oxy-hemoglobin dissociation curve to the left, and this in turn aids the absorption of oxygen, especially when there is an increase in the percentage of hemoglobin. (Meakins and Davies (1) p. 183.)

A striking increase in hemoglobin does actually occur. Paul Bert suggested the possibility of this method of adaptation and later proved it by actual test. The first rapid rise in hemoglobin percentage which occurs soon after reaching a high altitude seems to be caused by a diminution of the watery constituents of the circulating blood. Later there is an active formation of new blood cells with a marked increase in the reticulated red cells, as demonstrated in the report of the Peru Expedition. Thus, Meakins in the Andes showed an increase in his hemoglobin from his normal of 100 to the high level of 122–123 per cent. Bock's blood showed the same change. Two of the Indians who lived at the mines gave figures of 146 and 148 per cent. Their blood had an oxygen content of 22.8 cubic centimeters per 100 cubic centimeters blood. Miss Fitz Gerald, working with the Pike's Peak Expedition, had found in acclimated inhabitants at various levels an average rise of about 10 per cent of hemoglobin for every fall of 100 millimeters in atmospheric pressure.

As a result of these various factors of adaptation men have been capable of strenuous exertions at very high altitudes. For example, the Abruzzi Expedition in the Himalayas lived for two months at

17,000 feet without encountering any symptoms of mountain sickness. Later, seven of the Europeans spent nine days at 20,700 feet and some even climbed to 24,600 feet without distress. Meakins (1) (p. 186) describes the more recent Mount Everest Expedition where Bruce and Finch attained an altitude of 27,000 feet without oxygen. This would mean a partial pressure of oxygen in the inspired air of about 51 millimeters and in the alveolar air of about 26 millimeters.

The physiological changes in the organism caused by residence at high altitudes wear off in the course of a few days or weeks after a return to sea level, but it is not inconceivable that we may be able to prepare an aviator for a record altitude flight by having him live for several weeks on Pike's Peak and then hurrying him to the flying field. It does not seem practicable to acclimatize a man by means of brief altitude flights even if repeated at frequent intervals. It might be possible, however, to accomplish this result by having an aviator sleep every night in a low-pressure chamber or an ordinary respiration chamber in which the oxygen content was maintained at about half its normal percentages. In all such procedures great care must be taken not to damage the good health or morale of the aviator since these are assets of much greater importance than increased hemoglobin or a partially compensated alkalosis.

Studies made on mountain tops would not seem of much interest to the naval surgeon were it not for the bearing which they have on the problems of aviation. We can not tell how soon it will be until our aviators must remain for long periods at high altitudes in dirigibles or fight their planes in atmospheres so tenuous that life can not be supported without the aid of oxygen.

There are, of course, many factors in aviation besides altitude. We must take into account the cold, the excitement, the constant danger. There are sudden changes of pressure in a nose dive, and on a long descent it may amount to half an atmosphere. This causes great discomfort if the aviator is unable to "clear his ears" owing to a cold in the head with stoppage of the Eustachian tubes. The normal aviator has little difficulty from this source and, indeed, his pressure changes are mild when compared with those of the deep diver who may drop to a pressure of six atmospheres in less than a minute.

A more serious physiological problem is the sudden change of direction necessitated by stunt or combat flying. If the plane and the pilot and his heart and liver and blood, all swooping downward at a rate of 200 miles an hour, make a sudden turn upward the heart and liver and blood will be driven toward his feet with terrific force. Sometimes things "go black" for an instant, perhaps from anemia of the respiratory center, perhaps from some other cause. It is difficult to conceive of any physiological experiment which would cause more derangement to the organism.

Altitude does not become a factor in aviation until heights over 7,000–10,000 feet are reached. Above these levels individual differences become marked. In general, the men in good physical training stand altitude much better than those whose condition is not so good. Some men seem to be endowed by nature with special ability to withstand low percentage of oxygen, but even these men do badly when suffering the effects of disease or fatigue or dissipation. One of the best methods of determining the ability to respond to low oxygen is the rebreathing apparatus developed by Yandell Henderson and Pierce during the war. This device is similar to the machines used for measuring basal metabolism or the apparatus for mine rescue, but the oxygen is not replenished. The aviator, wearing a nose clip, breathes through a mouthpiece connected by means of tubing with a large spirometer which contains air. The $CO_2$ of his expired air is absorbed by means of soda lime so that there is no undue accumulation of this gas. As the test proceeds the 21 per cent originally present is gradually reduced to 8 or even 6 per cent. At this time the subject begins to show signs of distress and may become unconscious while sitting upright or may faint. As a rule the observing surgeon stops the test before this point. In fact, the aviator has been under careful observation during the whole procedure and records are made of his pulse rate, blood pressure, color, and responses to certain standardized tests, so that it is possible to ascertain the exact point at which he first showed signs of oxygen want. This rebreathing test has been extensively used in our Army and Navy and has proved to be most valuable. It is much more convenient than testing men in a low-pressure chamber and it gives much more reliable information than the simpler tests of vital capacity, maximum force of expiration, breath holding, etc.

The aviator seldom remains at high altitudes long enough to show the classical symptoms of mountain sickness but he may show the signs of acute oxygen want. It is almost impossible to study these phenomena in an airplane, but they may be observed by simulating rapid ascents in a low-pressure chamber. Thus, Lutz and Schneider (6), when they lowered the pressure at a rate corresponding to an ascent of 1,000 feet a minute, noted in about a quarter of the subjects an increase in pulse rate at the equivalent of 4,000 feet. There is a slow and gradual increase in pulse rate up to a level of about 14,000 feet, and after that it is more rapid. The increase averaged 15 beats at 15,000 feet and 20 at 18,000 feet. There is not much change in the blood pressure up to 15,000 feet. After that the systolic may rise and the diastolic fall a little. In those who respond poorly to high altitudes a sudden fall in blood pressure presages syncope. There is some evidence of an increased blood

flow during anoxemia. It must always be remembered that an aviator at high altitudes may be getting along very well while at rest but if his metabolism is increased by cold or excitement or physical work he will suffer acute oxygen want.

The greatest danger at high altitudes, and in all other conditions which produce oxygen want, is the treacherous effect on the brain. There is usually no warning of danger and the judgment becomes faulty and muscles weak while the aviator still feels perfectly normal. He may experience an unusual degree of exhilaration, not unlike that produced by alcohol. His judgment is about as reliable as a drunken man's and it is at this time that he must make the correct decisions. Some aviators have fallen unconscious as a result of anoxemia. Fortunately they usually recover after they have fallen far enough to reach air which contains more oxygen.

Paul Bert recognized that altitude flying could be made safer by breathing oxygen. Since his time there have been many devices for supplying this to aviators. The simplest apparatus is a steel cylinder of oxygen and a tube leading to the mouth. This can be adjusted either automatically or by hand so as to deliver enough oxygen to supplement that already present in the air. About half the oxygen will be wasted, since the flow is continuous during expiration as well as inspiration. In order to prevent this a device may be added to stop the flow during expiration or else allow it to collect in an expansile reservoir. Still more complicated attachments use face masks and valves and automatic regulating devices. The more complicated the apparatus the greater is the danger of something going wrong. It is necessary to strike a balance between weight and comfort and simplicity and the individual preferences of trained altitude flyers.

Probably the greatest amount of oxygen for the least weight can be secured by means of liquid oxygen in a Dewar flask. Liquid oxygen is not easy to handle and it is nasty stuff in case of an accident.

It is difficult to state at just what level oxygen should be employed. If an aviator is making frequent trips to high altitudes he will do well to start oxygen at 10,000 feet or even lower. It should always be used above 15,000 or 20,000 feet.

We finally come to the subject of the absolute ceiling for the human organism. Haldane (4) discusses this in masterly fashion on pages 361 and 380 of his book on respiration. He says that in order to go safely above 30,000 feet it is necessary to have an apparatus which makes it certain that the wearer breathes pure oxygen or at any rate oxygen not mixed with any other gas than $CO_2$. (There is some evidence that a low percentage of $CO_2$ may help a little by increasing respiration.) When an aviator goes much higher the

water vapor present in the lungs becomes the limiting factor. At body temperature the water vapor in the lungs always exerts a pressure of 47 millimeters mercury no matter what the altitude. If the barometric pressure in a vacuum chamber were reduced to 47 millimeters, the lungs would be entirely filled with water vapor and there would be no room for nitrogen or oxygen or carbon dioxide. At this point, or even a little higher, the liquids of the body would begin to boil. This is an extreme example, but it is doubtful if a man can live, even in pure oxygen, at a pressure of 100 millimeters. Under these conditions Haldane calculates that the alveolar air would contain 47 per cent $H_2O$, probably about 20 per cent $CO_2$ and 33 per cent of oxygen with a partial pressure of 33 millimeters mercury or about 4.3 per cent of an atmosphere. This pressure of oxygen is only one-twenty-third that of dry oxygen at atmospheric pressure, though the oxygen pressure in the inspired air is only reduced to a little over one-seventh. Matters might be helped a little by the reduced pressure which permits a greater velocity of the gas molecules.

Haldane goes on to say that if we were required to go much above 40,000 feet and to a barometric pressure below 130 millimeters it would be necessary to inclose the pilots in air-tight suits capable of resisting an internal pressure of say 130 millimeter mercury. At such altitudes a few breaths of the surrounding air might prove fatal.

End of Part IV

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## CASES ILLUSTRATING MAXILLO-FACIAL AND PLASTIC SURGERY

By Lucius W. Johnson, Commander, Medical Corps, United States Navy

This article is written with the hope of interesting some of the younger surgeons of the Medical Corps of the Navy in this work. There is a large field for it in the Navy and plenty of material.

When done with good judgment and proper technic, it returns large dividends in gratitude and appreciation. Most people who have facial defects suffer a certain mental handicap, so that correction of the deformity builds up the patient's self-respect and aids him in making his adjustments to service conditions or to civil life.

There is nothing new or original about the operations which are described here. They are standard methods and many of them have been in successful use for years. Most of them are elementary and form the foundation upon which more elaborate procedures are based. No attempt is made to describe the operations in complete detail because there are excellent textbooks available, such as J. Eastman Sheehan's Plastic Surgery of the Nose and Plastic Surgery of the Orbit, John Staige Davis's Plastic Surgery, Major Gillies's Plastic Surgery of the Face, also Blair and Ivy's Essentials of Oral Surgery. Because this branch of surgery is in its developmental stage, the current medical literature is full of articles with new and practical ideas.

From the cases that have passed through my hands while on duty at the Naval Hospital, Washington, D. C., typical cases in each group have been selected to illustrate the defects that are frequently encountered in the service, that can be corrected by any surgeon of average ability. The early treatment of facial injuries has already been discussed in the BULLETIN,[1] so no reference will be made to this important subject.

### THE ORBITAL REGION

Scars or other defects are particularly noticeable because the eyes are so largely concerned in the expression of the emotions. The outer third of the eyebrow is a favorite site for large pigmented moles and one frequently sees them an inch or more in diameter. They can be removed by an incision such as that shown in Figure 1, leaving an inconspicuous scar which is almost entirely within the eyebrow.

At the outer end of the palpebral fissure is a common location for small dermoids (fig. 2) which lie beneath the fascia and indent the bone. Cysts of the more superficial tissues are also common here. The cysts are freely movable, in contrast to the dermoids which are fixed in position.[2] The dermoids are usually noticed in early childhood, while the superficial cysts are more prominent about the time of adolescence. These growths are easily removed through an incision within the limits of the eyebrow, the scar of which is entirely concealed. If a dermoid leaves a considerable depression in

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[1] Johnson, L. W., U. S. Nav. Med. Bull., 24; 3, 1926.
[2] Johnson, L. W., J. A. M. A. 86; 14 (Jan. 2), 1926.

the bone, it may be filled by cutting a small flap from the adjacent temporal muscle and swinging it into the hollow.

Radical operations on the frontal sinuses, now fortunately less popular than in past years, may leave very conspicuous depressed scars; and when these occur, as in Figure 3, in otherwise beautiful young ladies, their correction is important. They commonly require operation in two stages: First, excision of the scar and freeing the tissues from the bone; and, second, replacing the lost bony ridge by a carefully carved piece of costal cartilage.

### The Nose

Reconstructive surgery of this organ antedates history, but it is only since the late war that the methods have become so systematized and simplified that they can be successfully used by the average surgeon. In the Navy there are many men with deformed

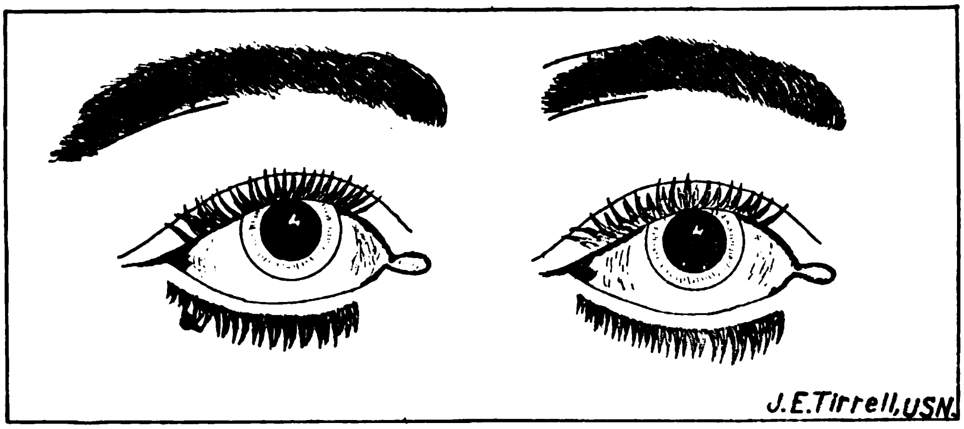



FIG. 1.—Incision for removing growth from outer third of eyebrow

noses, due to injury or other causes, who are glad to offer themselves as subjects for surgery, and excellent results have been reported in the BULLETIN by Camerer, Locy, and others.

The nose is a relatively safe site for surgery. Its blood supply is rich and infection is a rare complication. Either the skin or the mucous membrane can be lifted from the bone and cartilage without danger of necrosis. If too much bone is removed from a hump nose, a little can be replaced, and if a cartilage implant for saddle nose does not give satisfaction, it can be removed without danger or disfigurement.

Those who are beginning this work would do well to employ a plaster cast for study in their first few cases. Lieut. Commander A. W. Chandler, Dental Corps, United States Navy, has made many of these for me, and they have been of great assistance. They also make a valuable record. Photographs are also valuable for study and for record. On the cast one can build up the nose with wax or

dental modeling compound until the exact size and shape of the required cartilage is determined. (Figs. 4, 5, and 6.) The wax can then be removed, sterilized, and used as a guide during the operation while carving the cartilage.

An important point in reconstruction of the nose is to have the shape of the organ in keeping with the other features. A beautiful Greek nose on a fat face with irregular features is grotesque. It is also important not to build up the upper third of the nose so much as to obscure the normal prominence of the nasion, as was done in Figure 7. Overcorrection, by inserting too much cartilage, is the commonest error in correcting the saddle nose. To appreciate this point, those who are interested should visit the Post-Graduate Hospital in New York and see the delicate and beautiful rhinoplasties which are done there by Dr. J. Eastman Sheehan.

All the operations about the nose are best done under local anesthesia with novocain. The principal nerves are the nasociliary, which emerges from the median side of the orbit, and the infraorbital. These should be blocked and then the tissues at the junction of the nose and cheek infiltrated down to the periosteum. Careful injection about the philtrum is also important.

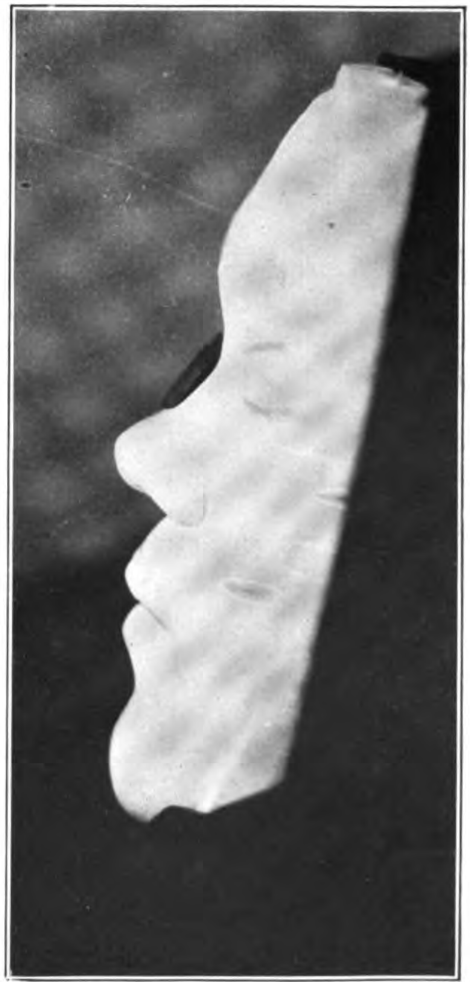
The incision used for removing a bony hump or implanting cartilage may be either within or without the nose. Figure 8 shows the common external incisions. The one across the bridge should be placed in one of the natural furrows, and its principal use is when one desires to lengthen the nose and make its tip more angular. For removing a bony hump or correcting the ordinary saddle nose, the incision below the tip of the nose is better because the scar is less conspicuous. After operation no dressing is required other than compound tincture of benzoin painted over the wound. As one becomes more experienced in this work he will come to prefer one of the various incisions through the mucous membrane within the nose.

After the incision is made the tissues are separated from the bone by sharp or dull dissection. For the hump nose, chisels can be borrowed from the dentist which are suitable for removal of the excess bone. Cartilage implants for saddle nose should be placed against the bone so that they will become firmly fixed in place.

Cartilage for implantation may be secured from the fused cartilages of the sixth, seventh, and eighth ribs, which usually form a broad plate. A vertical incision is made down through the rectus sheath and muscle, which extend as high as the fifth rib, until the cartilage is exposed. The muscle attachment is cleared until a sufficient area of cartilage is exposed and a piece slightly larger than required is removed. The wound is carefully closed. This is easily done under local anesthesia without discomfort, but for a few days

FIG. 2.—CYST AT OUTER ANGLE OF EYE. A COMMON LOCATION FOR THESE GROWTHS

FIG. 3.—CONSPICUOUS SCAR FOLLOWING RADICAL OPERATION FOR FRONTAL SINUSITIS



FIGS. 4 AND 5.—USE OF CAST TO DETERMINE SIZE AND SHAPE OF CARTILAGE REQUIRED TO CORRECT SADDLE NOSE

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FIG. 6.—CASTS AND PHOTOGRAPHS AS PERMANENT RECORDS OF PLASTIC OPERATIONS

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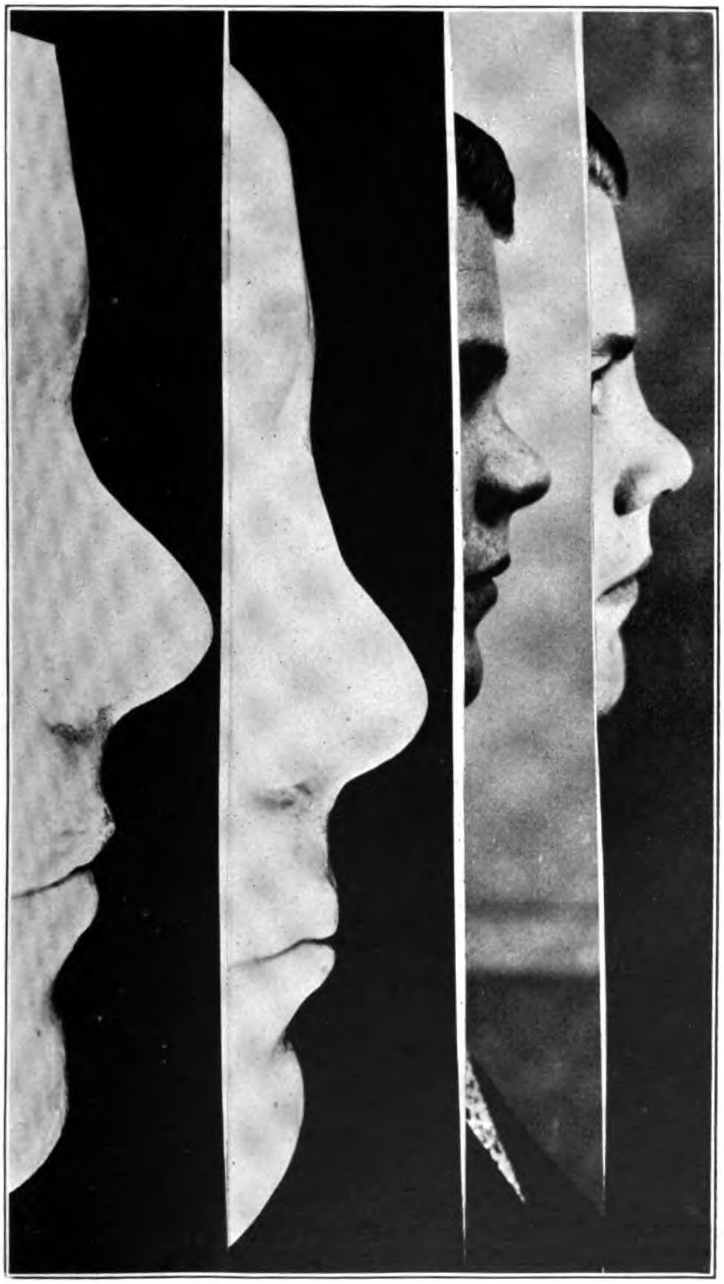

FIG. 7.—OVERCORRECTION OF NASAL DEFORMITY WITH OBLITERATION OF THE NORMAL PROMINENCE OF THE NASION

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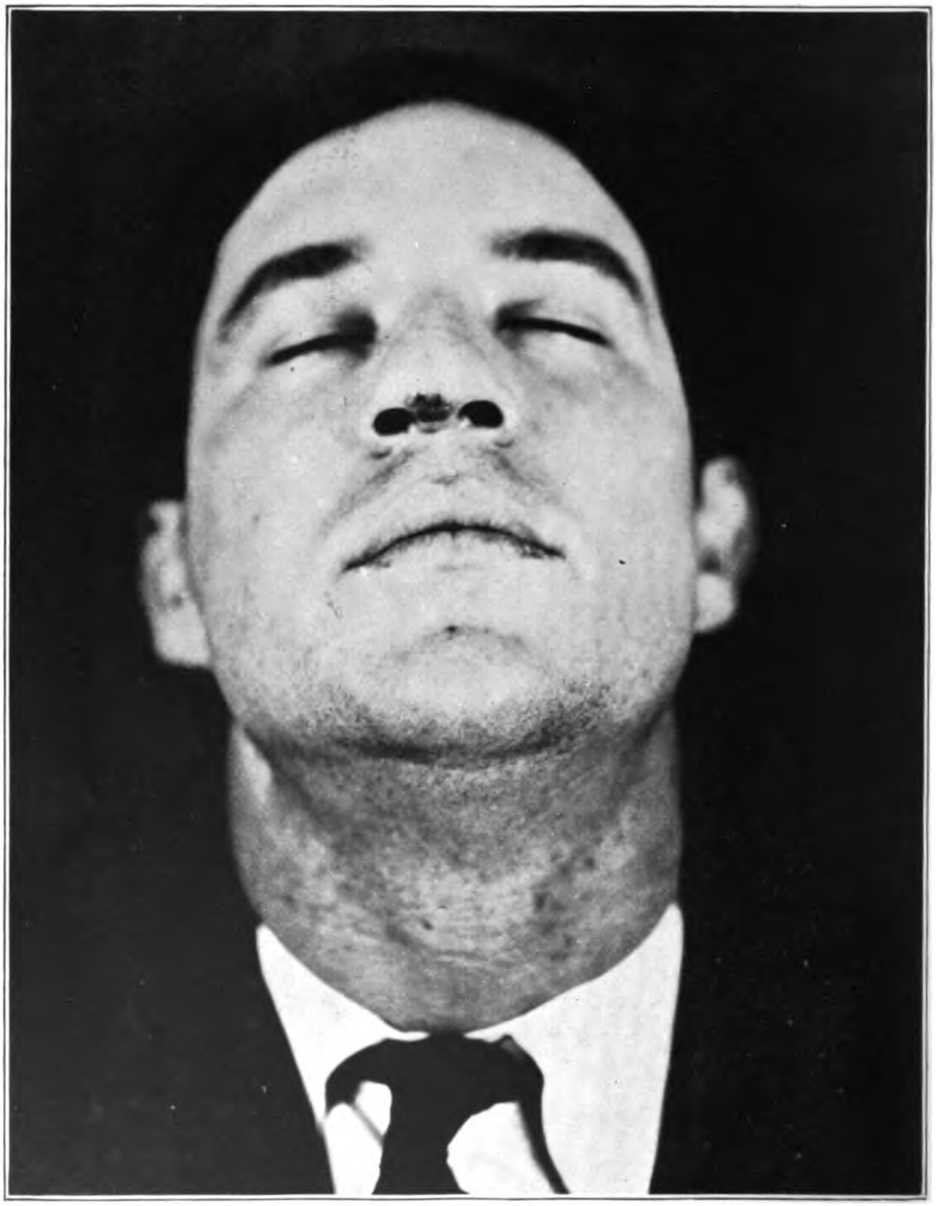

FIG. 10.—INCISION AT TIP OF NOSE, USED IN CORRECTION OF NASAL DEFORMITIES. THE DARK AREA IS COMPOUND TINCTURE OF BENZOIN, USED AS AN OCCLUSIVE DRESSING

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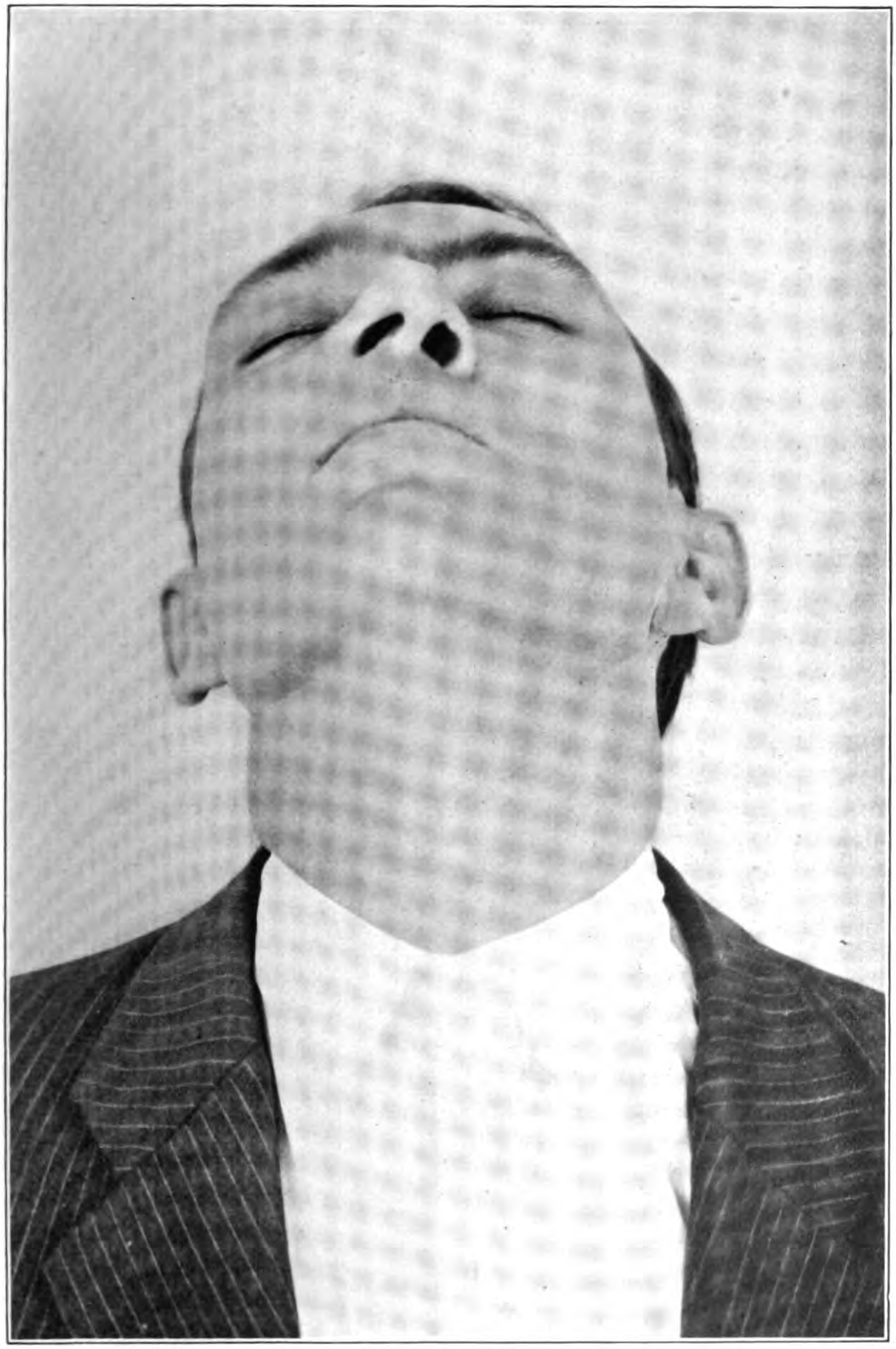

FIG. 11.—DEFORMITY OF NOSE WITH DEPRESSION OF CHEEK AND SUPRA-ORBITAL RIDGE

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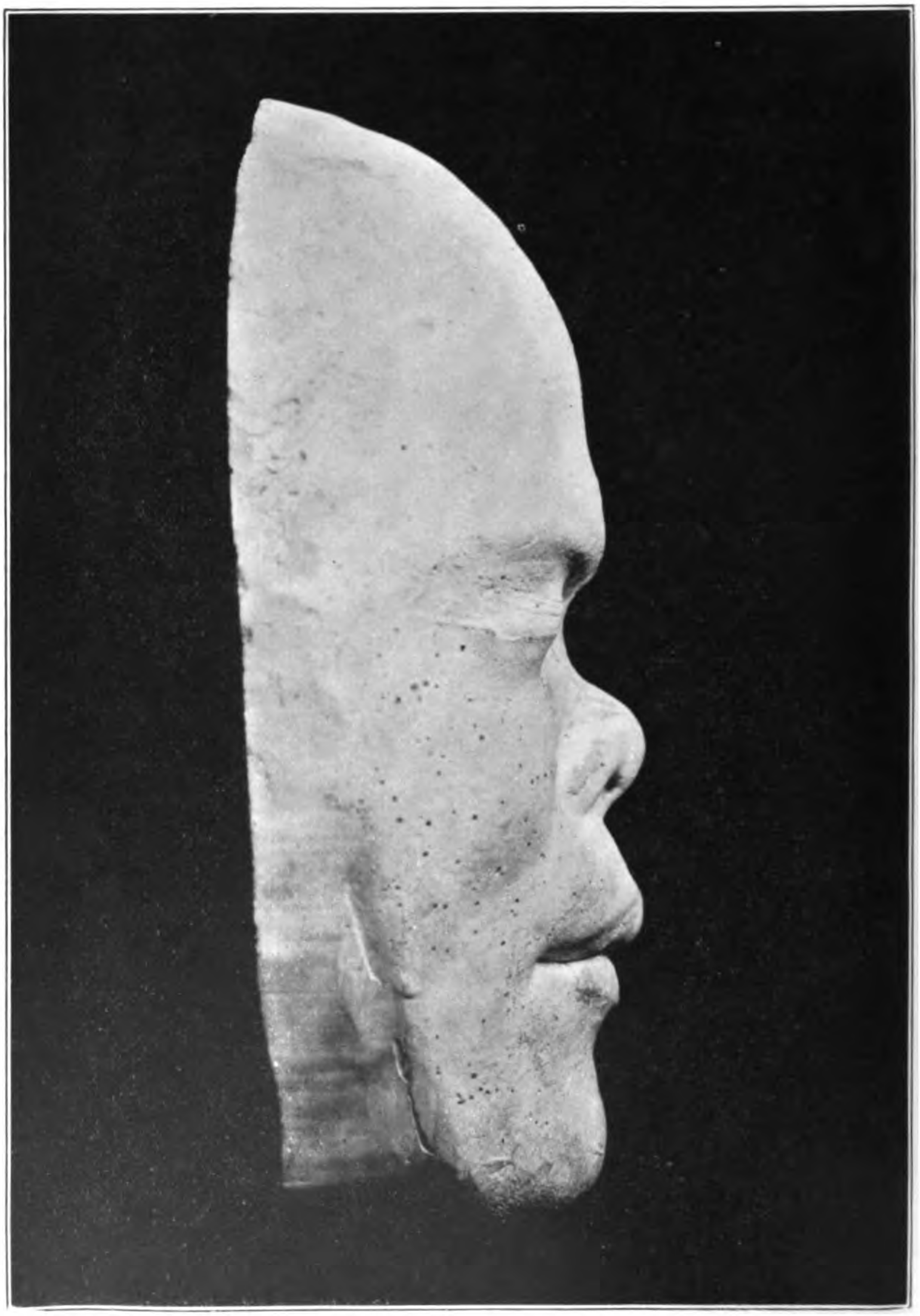

FIG. 12.—INFANTILE NOSE. DUE TO DESTRUCTION OF NASAL BONES BY DISEASE DURING CHILDHOOD

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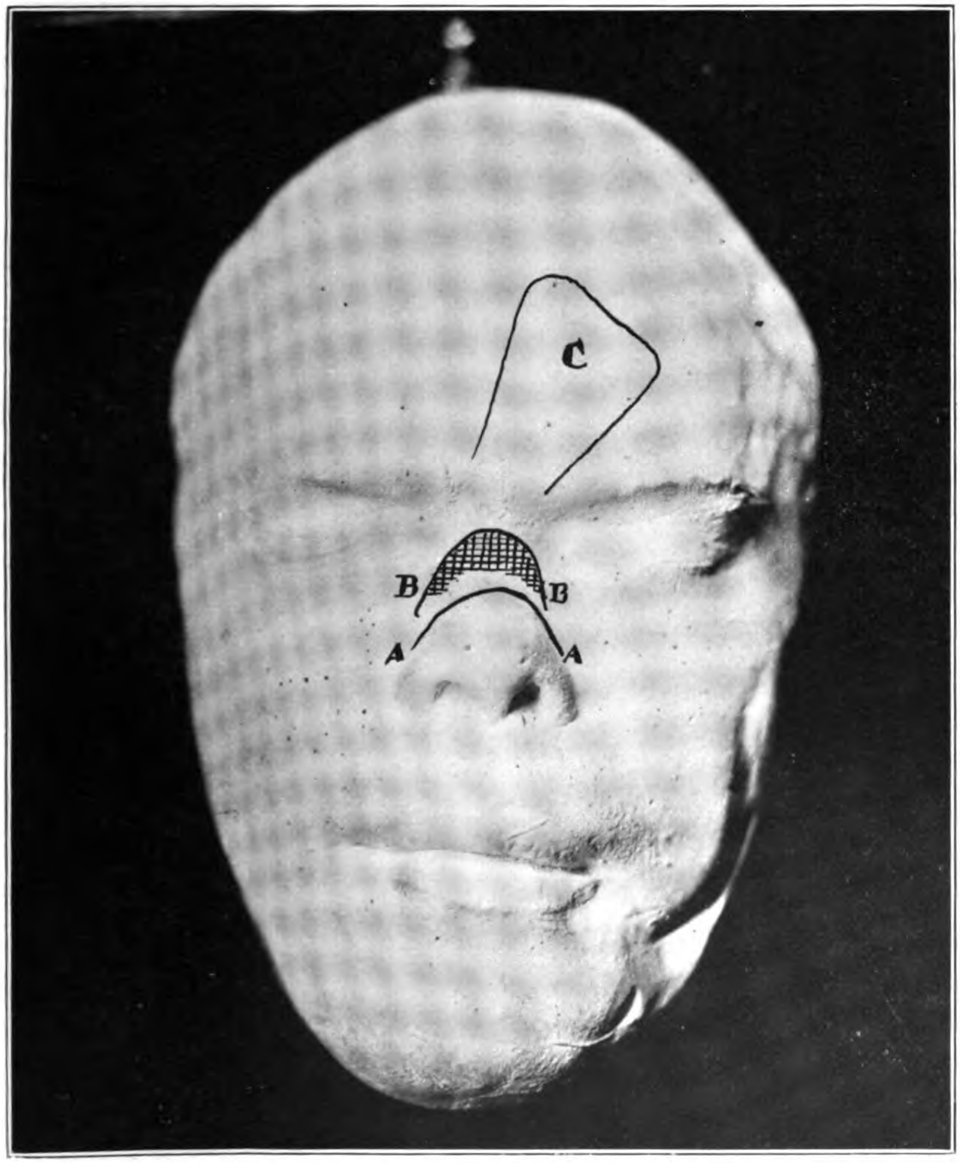


FIG. 13.—METHOD OF CORRECTING THE TYPE OF DEFORMITY SHOWN IN FIGURE 12. THE INCISION A-A ALLOWS THE TIP TO BE BROUGHT DOWN TO THE HORIZONTAL. THE FLAP B-B IS TURNED DOWN TO LINE THE TIP. THE FLAP C IS SWUNG DOWN TO COVER THE RAW SURFACES

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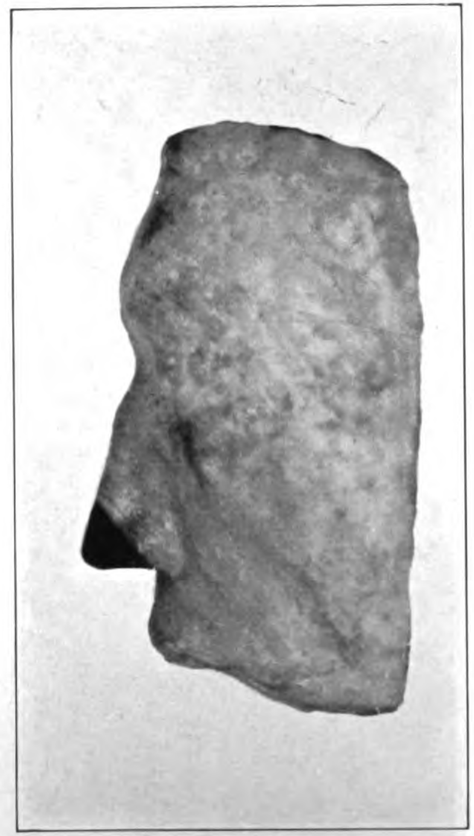
FIG. 14.—LOSS OF THE TIP OF THE NOSE; DUE TO DISEASE



FIGS. 15 AND 16.—WAX RESTORATION OF NOSE ON CAST

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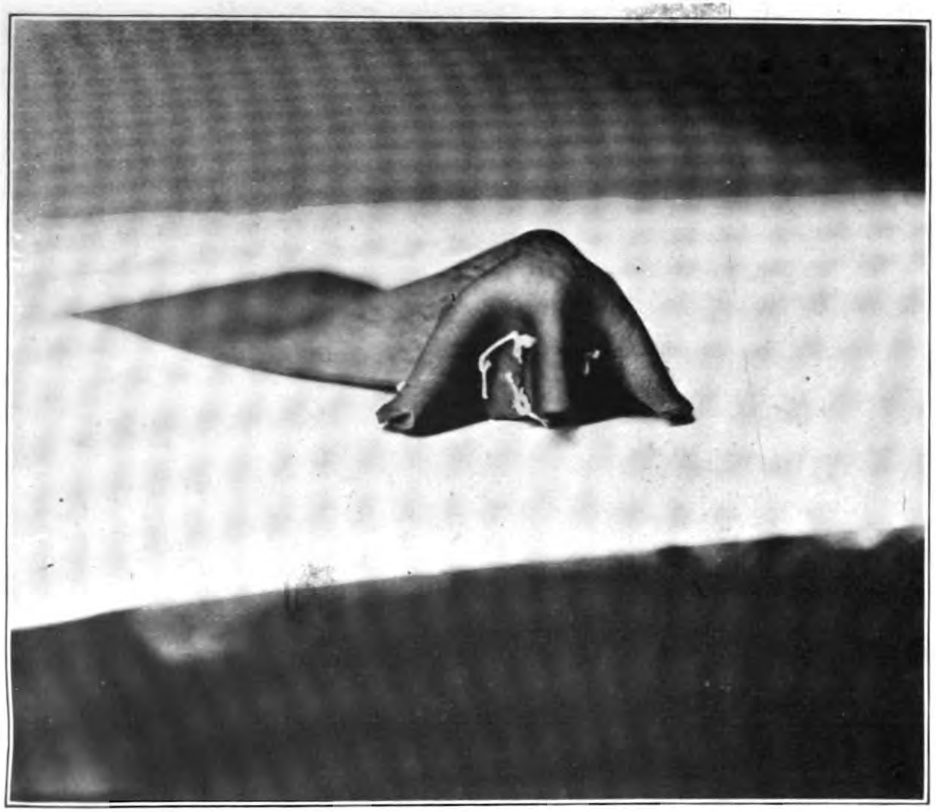

FIG. 18.—METHOD OF FOLDING FLAP SHOWN IN FIGURE 17

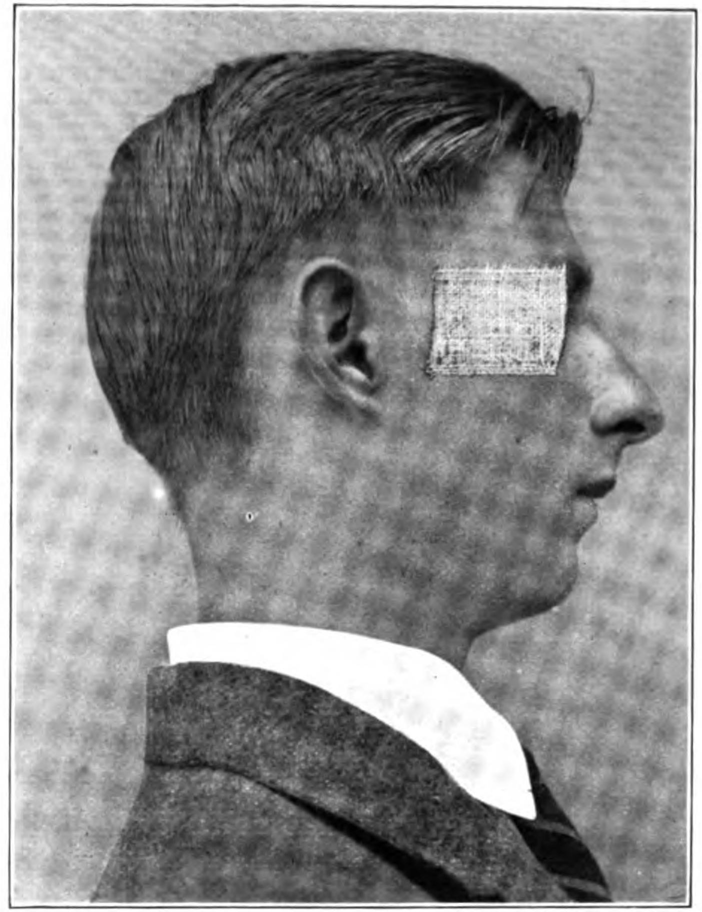

FIG. 19.—ANKYLOSIS OF JAW BEGINNING IN CHILDHOOD. THIS SHOWS THE CHARACTERISTIC ADOLESCENT PROFILE

FIG. 20.—ANKYLOSIS OF THE JAW. NOTE THE NORMAL FULLNESS OF THE ANKYLOSED (LEFT) SIDE AND THE FLATNESS OF THE NORMAL (RIGHT) SIDE

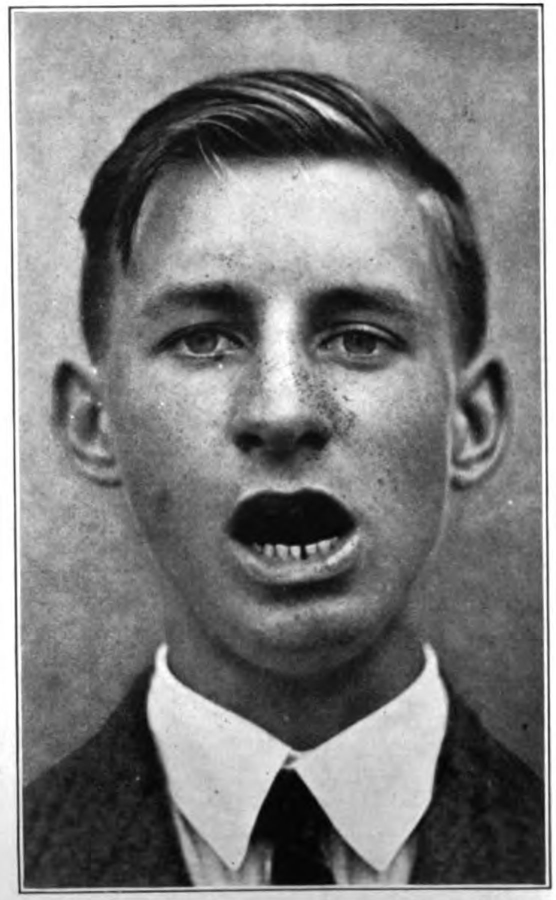

FIG. 21.—ANKYLOSIS OF THE JAW. SHOWS THE LIMIT OF MOVEMENT OF THE JAW AND DEVIATION TOWARD THE ANKYLOSED (LEFT) SIDE

FIG. 22.—INCISION FOR APPROACH TO TEMPERO-MANDIBULAR JOINT

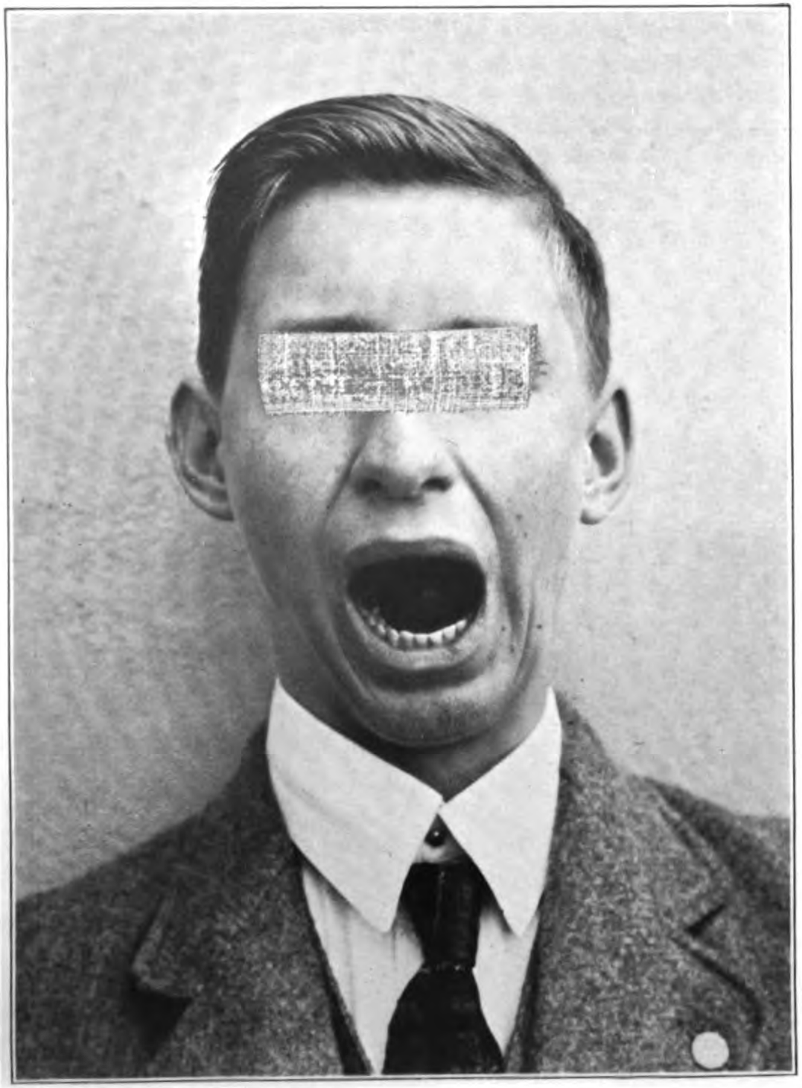

FIG. 23.—SHOWS RANGE OF MOTION AND SLIGHT DEVIATION OF MANDIBLE TWO YEARS AFTER OPERATION FOR ANKYLOSIS

FIG. 24.—IMPROVEMENT OF PROFILE TWO YEARS AFTER OPERATION FOR ANKYLOSIS. COMPARE WITH FIGURE 19

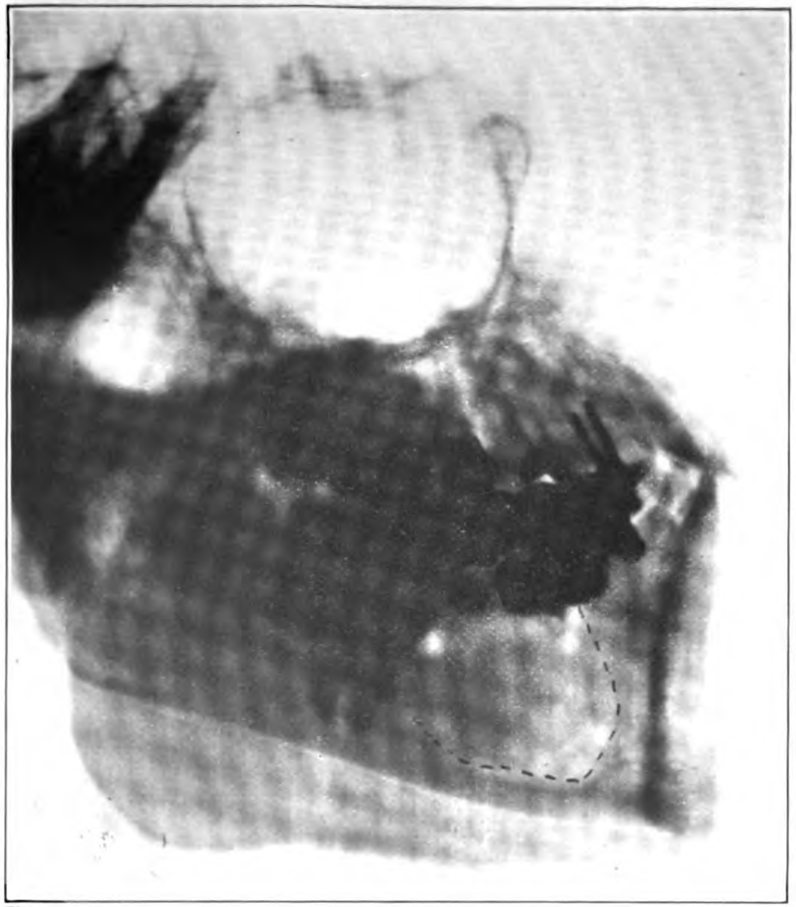

FIG. 25.—LATERAL VIEW OF DENTAL CYST

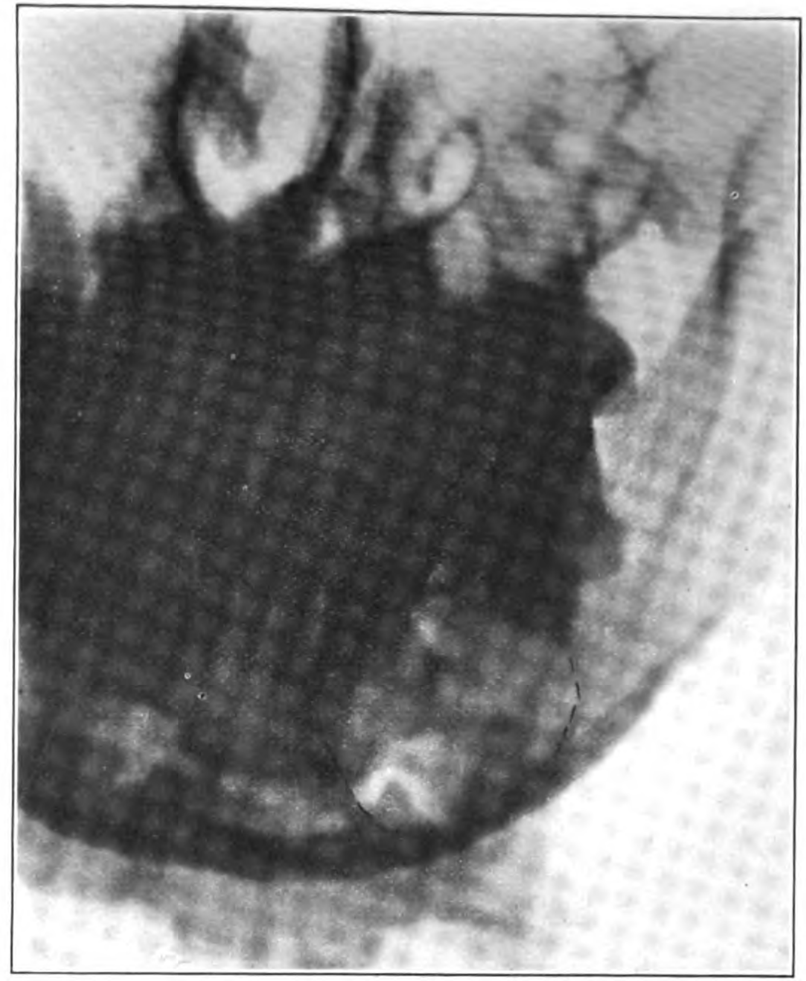

FIG. 26.—FRONT VIEW OF DENTAL CYST

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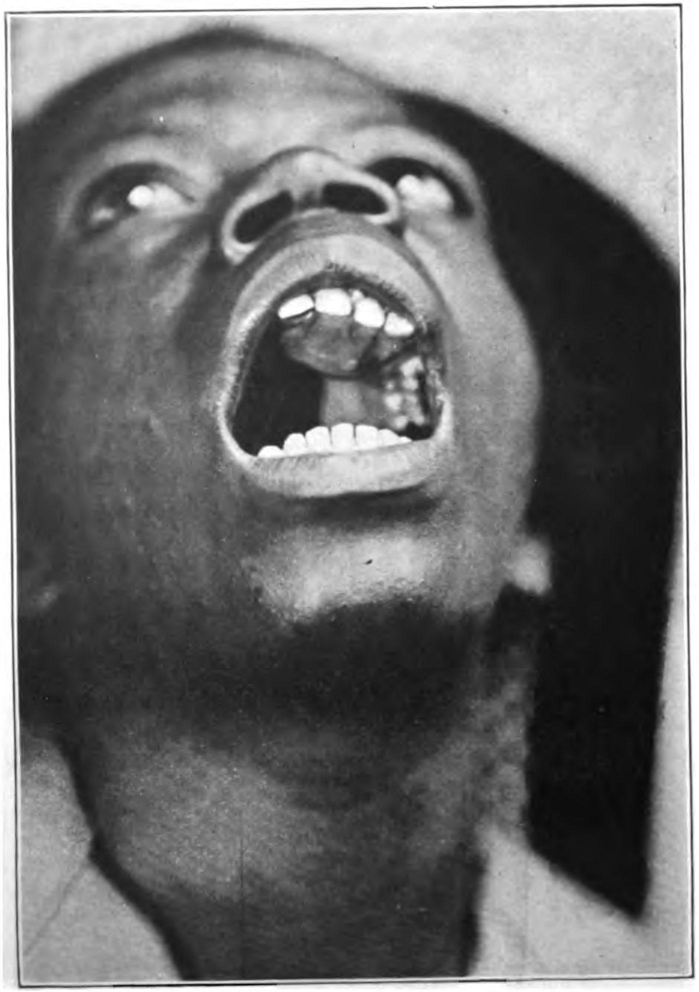

FIG. 27.—GIANT-CELL TUMOR OF MAXILLA

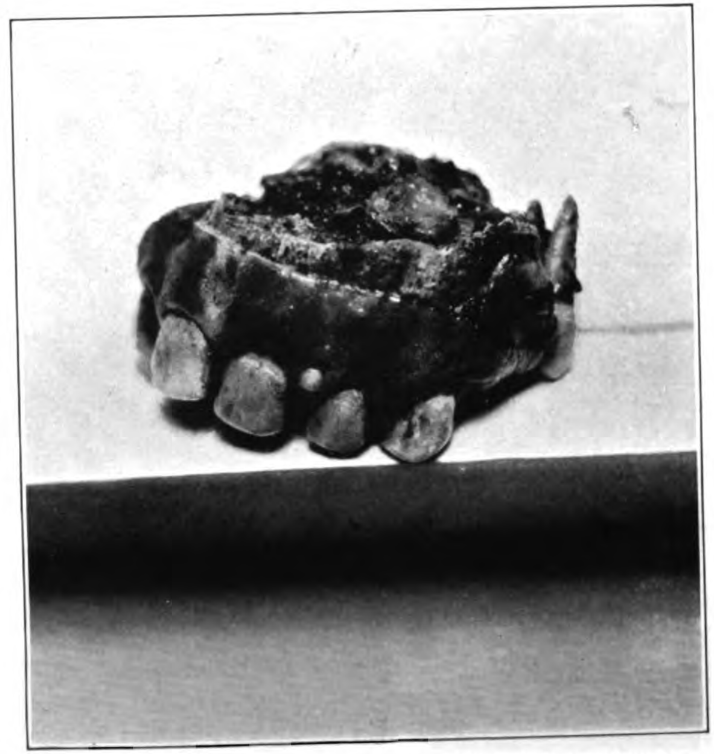

FIG. 28.· GIANT-CELL TUMOR OF MAXILLA AFTER REMOVAL

after the operation the patient finds this wound very painful, while the main operation, on the nose, causes little discomfort.

Occasionally we see a case in which, following a submucous resection, there is collapse of the supporting structures of the nose, with considerable obstruction to breathing. The ability to breathe through the nose is one of those minor blessings which one never appreciates, except in retrospect after they are lost. Relief can be afforded by inserting a strip of cartilage, notched and bent at an angle, so that the lower end rests against the maxilla while the upper end rests on the nasal bone. (Fig. 9.) Figure 10 shows the incision, below the tip of the nose, used in a case of this sort. The operation completely relieved the patient's respiratory difficulty and corrected his profile.

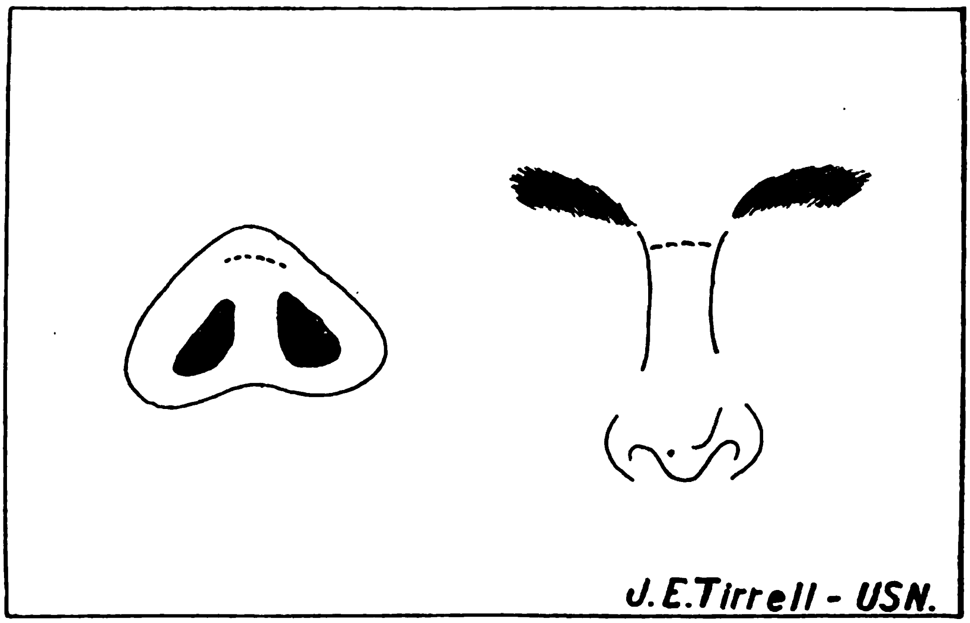


FIG. 8.—External incisions for correcting nasal deformities

Injuries from blows severe enough to fracture and displace fragments of the bones of the face are not uncommon. Figure 11 shows this type of deformity, in which the whole nose is laterally displaced and there are deep depressions in the cheek and the supraorbital ridge. It was caused by the kick of a horse during childhood. The first step in correction was a submucous resection of the septum. At the second operation an incision 2 inches long was made beneath the upper lip and the lip and cheek were raised from the bone. The nasal bones were chiseled loose from the maxilla and the whole nose mobilized. A vertical strip was removed from the posterior edge of the right nasal bone so that the nose could be brought back to the mid line. Through the incision deep sutures were taken in the soft tissues of the left cheek, gathering them together and pulling them

toward the mid line. The final stage will be building up the supra-orbital ridge by a cartilage implant.

Cases are frequently seen in which, because of disease during childhood, the nose fails to grow with the other features. Figure 12 shows a cast of such a patient, in whom the nasal bones were destroyed at the age of 7. He now has a 7-year-old nose on an adult face. Cases of this sort can be greatly improved by lengthening the nose in the following manner. At the first operation an incision is made entirely across the nose just above the alæ, through all tissues

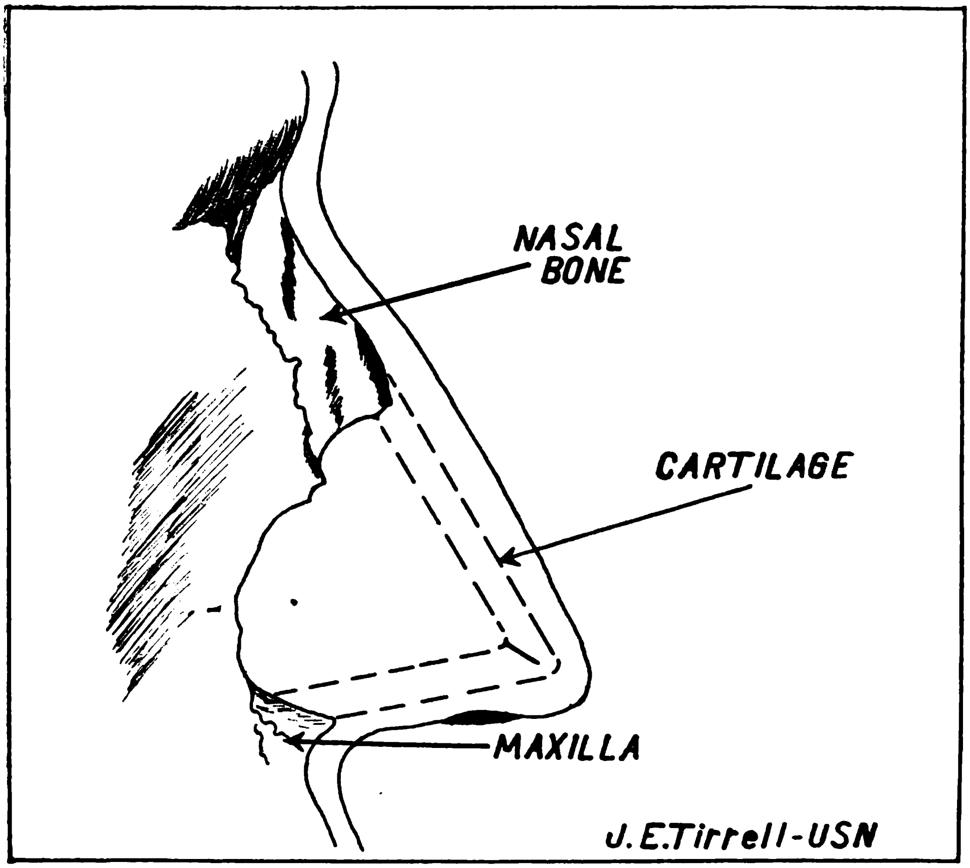


FIG. 9.—Cartilage implantation to support nose after removal of septum

(Fig. 13), and the tip of the nose is brought down to the horizontal. A flap from the bridge of the nose is then turned down, with the skin surface inward, to form the epithelial lining of the tip. At the second operation, done a week or so later, a forehead flap is turned down to cover the raw area over the bridge and the flap that was turned down at the first operation. At the third operation the pedicle of the forehead flap is cut and returned to its original position and the remaining raw area is covered with a full-thickness graft from the arm or other source. The surgical work in the case pictured here has not yet been started but the operation is a standard

one for this type of defect. Additional cartilaginous support is rarely necessary for noses made in this manner.

When the tip of the nose is lost, as in Figure 14, restoration is a more difficult and complicated matter, requiring considerable preliminary study. We plan to restore this nose by a forehead flap cut

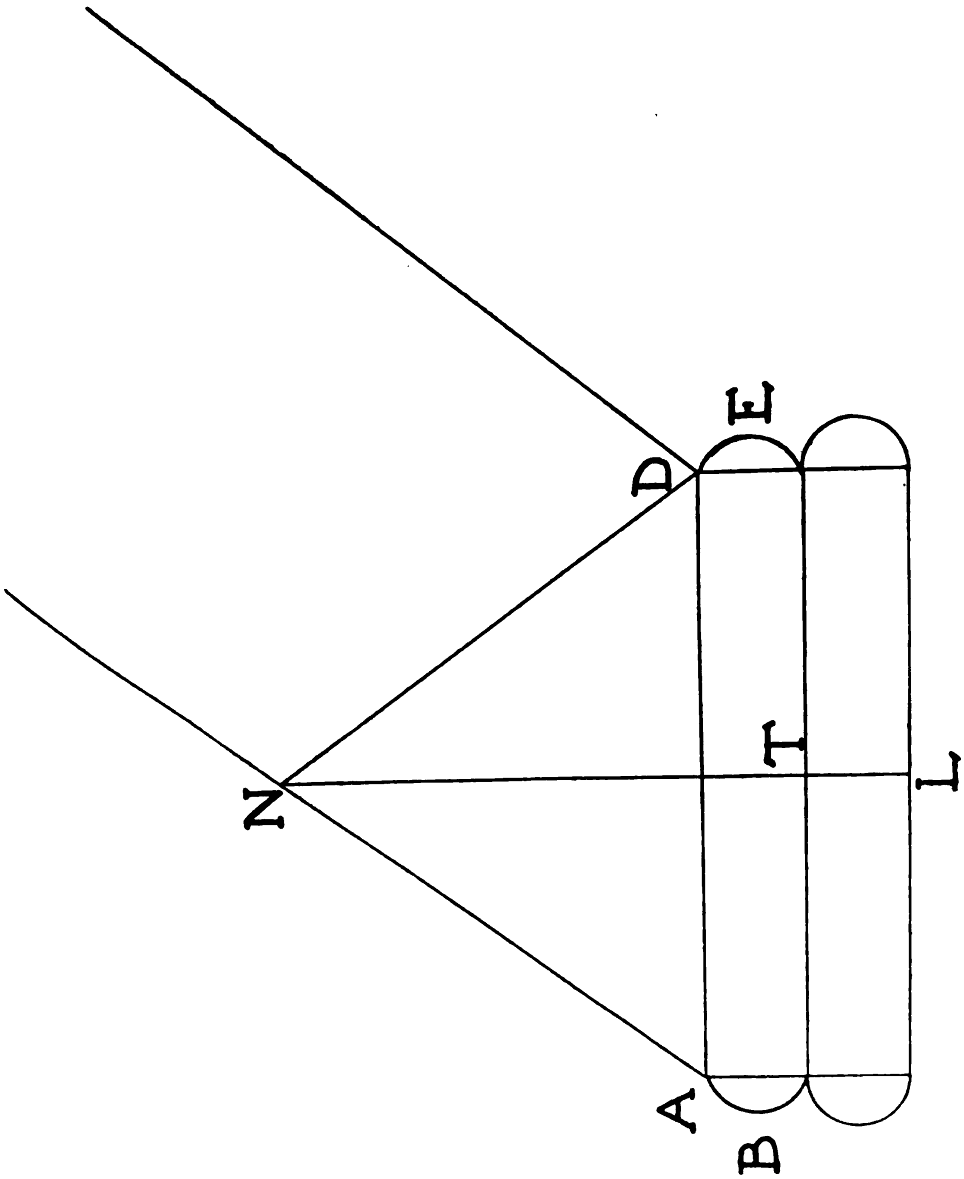


Fig. 17.—Method of planning forehead flap. Measurements are: NT—nasion to tip; TL—tip of nose to tip; BE—across nose from cheek to cheek; AD—across nose above alae; NA—nasion to tip of ala; NB—nasion to widest point of ala. (Ivy (8))

in the manner for which Ivy [8] gives the credit to V. P. Blair. It is an axiom, in cases of this sort, that loss of tissue due to disease is more difficult to repair than when the condition is due to injury. A plaster cast should be made and the desired nose built up on it in wax, as in Figures 15 and 16. The measurements of this nose are then taken and a diagram of the flap drawn as in Figure 17. A pattern of this

[8] Ivy, R. H., J. A. M. A., 84, 181 (Jan. 17), 1925.

is cut from tin foil, to be sterilized for use during the operation. The portion B–T–E–L of the flap is to be folded in to make the lining of the nose and the columella. Figure 18 shows the flap cut out of rubber and illustrates the manner of folding it to make the columella and the lining of the nose.

The first step of the operation is to cut away the scar tissue until perfectly healthy tissue with good circulation is reached. This applies not only to the remnant of nose but also to the attachments of the alæ and the remaining part of the septum. The tin-foil pattern is then laid on the forehead in the proper position and the flap is carefully cut through the whole thickness of the skin. After the flap is cut and raised, it is folded, as in Figure 18, and held by a few through-and-through sutures. The folded flap is then sewed in place with careful approximation of all the edges. After 10 days or more, when the flap is well united and the new circulation well established, the pedicle is cut off and returned to its original position and sutured there. The remaining raw area is covered with a full-thickness free graft from the arm, eyelid, prepuce, or other area.

### Ankylosis of the Jaw

Limitation of the movement of the jaw may be due to many causes, the commoner ones being inflammatory infiltration of the muscles, bands of scar tissue, and changes within the joint, the last being true ankylosis. Changes in the joint may be due to suppuration or to injury. In many cases no definite cause can be determined. If the process starts in childhood, the interference with the function of the mandible prevents its proper development and gives a characteristic profile, as shown in Figure 19. In the full-face view there is noted a normal fullness on the ankylosed side, while the side with the normal joint shows a distinct flattening. (Fig. 20.) On opening the mouth there is a deviation of the mandible toward the side of the ankylosis. (Fig. 21.) It is important to observe all these signs carefully because it has repeatedly happened that the operation was done first on the normal side, requiring a second operation on the ankylosed side.

Of the various operations for this condition, the one most favored is that which attacks directly the diseased joint. The usual incision is shown in Figure 22. After the skin flap is raised and the fasciæ incised, one should locate the branch of the seventh nerve which runs above the zygoma to the frontalis and the orbicularis palpebrarum. This nerve must be carefully guarded. After separating the posterior fibers of the masseter muscle from the zygoma, one comes down to the joint. The capsule is opened and the cause of the limitation of motion is sought. In the case pictured here, as in most

cases, removal of the condyle was necessary. This is a delicate piece of work because of the proximity of the third division of the fifth nerve and the internal maxillary artery. Figure 23 shows the increased range of motion and Figure 24 shows the improvement in the profile, two years after the operation was done.

### New Growths Within the Mouth

Of the benign lesions in this region, the ones we have most frequently encountered in the Navy are epulis, leukoplakia, giant-cell tumor, and dental cyst. Any one of these may be the precursor of a malignant growth, but in the service we are usually fortunate enough to detect them in the early stage and so avoid the more serious developments.

In all lesions about the mouth the medical officer owes it to himself as well as to the patient to take advantage of the opportunity for consultation with his dental colleague. The dentist and the surgeon, working as a team, will produce results superior to those that either can achieve alone. The knowledge and training of each supplements that of the other, and both are essential.

Epulis is an unsatisfactory term which may be applied to any tumor on the gums, but it is generally used in reference only to connective-tissue tumors. The usual fibrous type is now considered as having its origin from the periosteum or peridental membrane. Treatment is removal of the growth, together with the involved teeth periosteum, and alveolar process.

Leukoplakia is frequently seen in its various stages. Most of our patients have been pipe smokers. Our custom has been to clean the teeth and mouth, have a Kahn test made, and induce the patient to stop smoking. After all unfavorable conditions have been corrected, we wait for 7 to 10 days and then, unless the condition has greatly improved, we remove the affected tissue at once by electrodesiccation. The only ones we have seen go on to malignancy were those which were irritated by having iodine, silver nitrate, or other caustics applied. Radium treatment has been successful in all of our advanced cases.

Dental cysts are less common. Figures 25 and 26 show a case of this sort occurring in the mandible. This officer had a tooth extracted 11 years ago, but one root was left. Some years later a swelling was noticed and this gradually increased in size. The operation was done under mandibular block anesthesia. An incision was made, within the mouth, along the upper edge of the swelling. The soft tissues were elevated from the bone and the thin outer bony wall removed. The delicate lining membrane was then carefully removed. The cavity was curetted and packed. Dressing was done daily by the dentist and the cavity slowly filled.

Giant-cell tumors are not uncommon and, in their earlier stages, are often considered as simple epulis. The term "sarcoma" should not be used in connection with these tumors for they are not malignant and metastasis is never seen. Recurrence after incomplete removal is the rule. Figure 27 shows such a case, with slow growth over a period of years. After removal of the fragment shown in Figure 28, the area rapidly healed but slow recurrence is expected because it was not feasible to remove the entire growth.

### Correction of Scars

Lacerations of the face by broken glass in automobile accidents are common sights in the emergency service of all hospitals to-day. The ultimate outcome of the injury depends almost entirely on the judgment and skill used by the one who first treats the patient. Careful cleansing of the wound, hemostasis, and accurate suturing are the primary essentials but one must also watch for the earliest evidences of infection, open the wound, sterilize it, and resuture it as soon as the infection is controlled. Correction of scars of facial injuries gives excellent training in the principles of plastic surgery, with little chance of failing to benefit the patient.

Sometimes the lacerations are so severe and extensive that the tissue is literally cut to ribbons. Replacement of these ribbons in their exact position may require considerable study, and errors are not uncommon. Such a case is shown in Figure 29. The cuts extended through the full thickness of the lip and flaps B and C (Fig. 30) were transposed in the repair at the time of the accident. To correct this, the original flaps were recut through the full thickness of the lip, the scar tissue was removed and the flaps returned to their correct position, as in Figure 31. Return of muscular action and function to the lip was rapid but edema persisted (Fig. 32) until the new circulation was entirely established. The ultimate result was excellent.

### Other Defects of the Lip

Any irregularity of the muco-cutaneous junction is very conspicuous. Such irregularities frequently follow lacerations or operations for harelip. Correction of these defects is a simple, yet delicate, operation and produces great improvement in the appearance. We get a number of these cases every year.

Double lip is a form of macrocheilia in which there is a redundancy of the mucous membrane and submucous tissue, producing a fold when the lips are separated. Some degree of this is not uncommon in the colored race but in whites it forms a conspicuous and unpleasant defect. It is easily corrected (Fig. 34) by excising

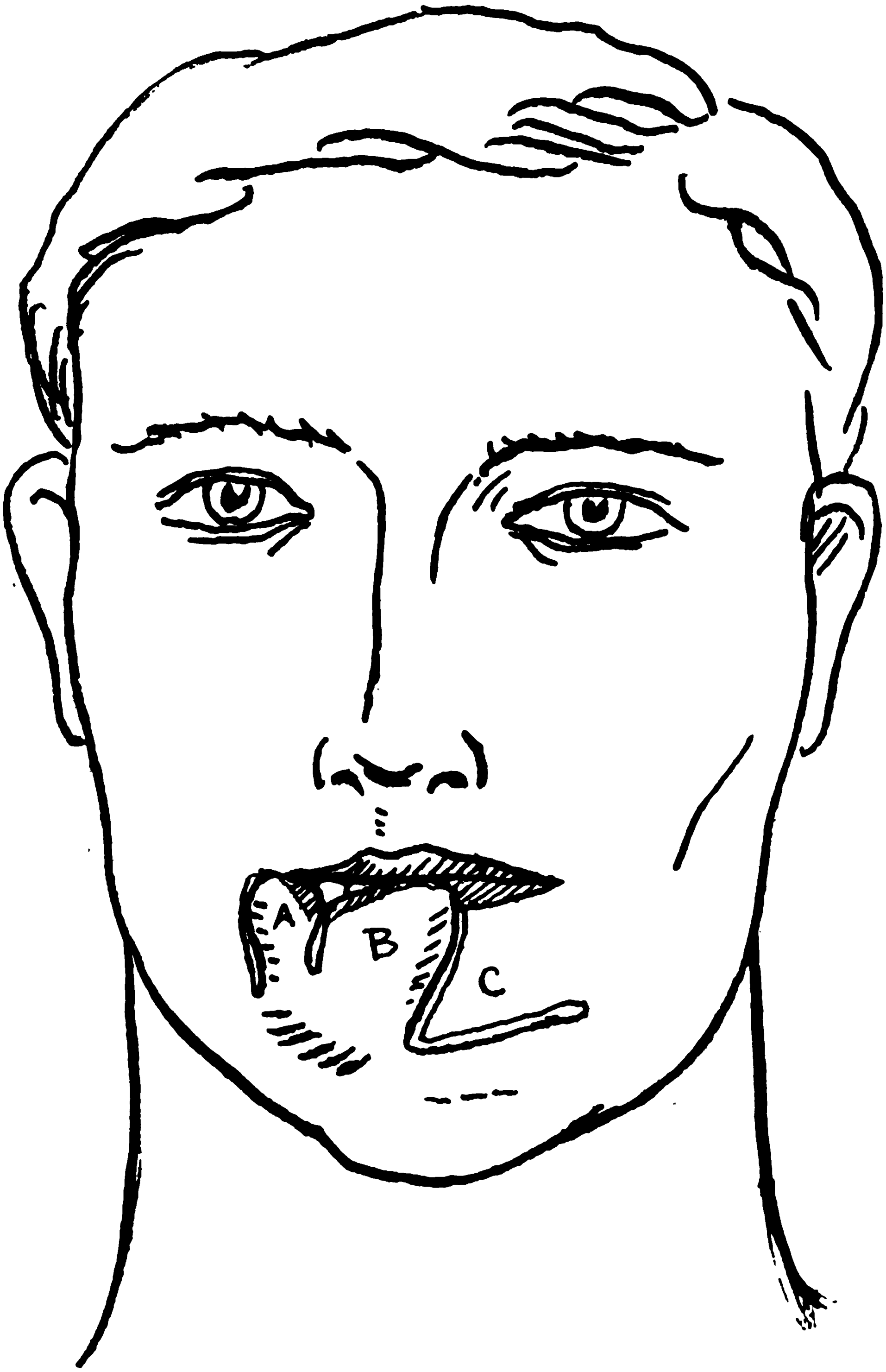


Fig. 30.—Diagram of misplaced flaps shown in Figure 29

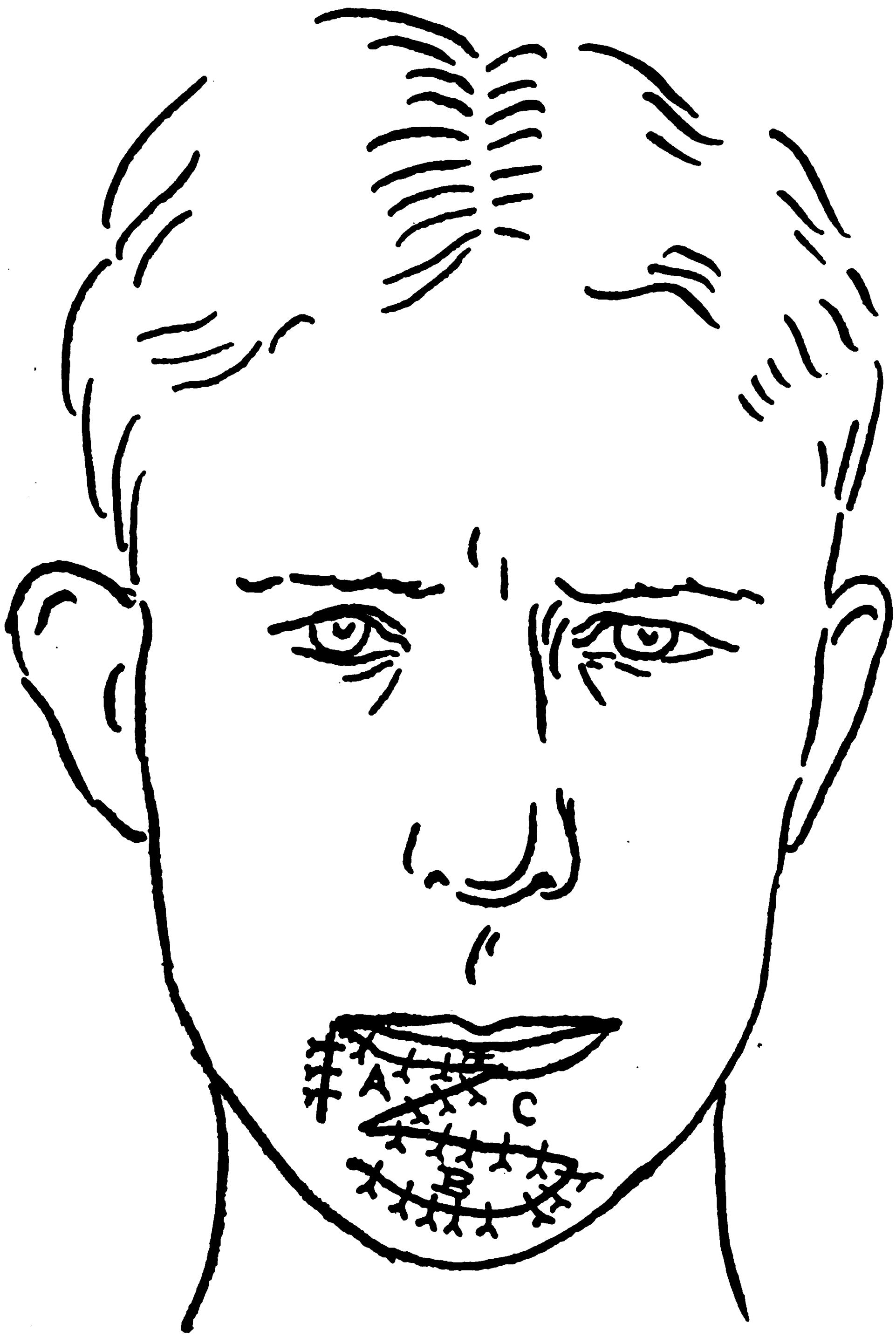


FIG. 31.—Excision of scar and correction of misplaced flaps

a crescentic piece of mucous membrane beneath the lip, close to its attachment to the maxilla. The excised part should extend the whole width of the mouth, from side to side. After the correct amount of the mucous membrane is removed, the excess of submucous tissue is dissected out and the wound closed.

Complete loss of both lips makes a difficult problem, especially when the condition is due to disease instead of injury. Healing after an ulcerative process leaves a great deal of scar tissue which infiltrates for a considerable distance and impairs the blood supply. One has to cut back from the edges until the circulation is found to be good enough for plastic work. Such a case is shown in Figure 35. This shows the mouth opened as widely as possible. The lips and columella were destroyed and replaced by wide bands of scar tissue. This was further complicated by an obliteration of the nasopharyngeal opening, so that swallowing was difficult and nose breathing impossible. There was also a psychosis which required careful watching after each operation.

This case also illustrates the disappointments which one experiences in this line of work more often than in the usual run of surgery in the Navy. After each operation there was some recurrence of the ulcerative process and none of the operations was quite as successful as one expects in the average case. But the patient was willing to undergo any amount of suffering if he could be improved. Over a period of two years we did 20 minor operations in preparation for the principal one, which was a double-pedicled scalp flap for the upper lip. This flap necrosed, the only scalp flap I ever knew to fail, and the patient returned to his home with relatively little improvement to show for his two years of patient suffering.

The first operation was to enlarge the mouth so that he could breathe and eat better and so improve his general condition. Lateral incisions were made through the full thickness of the cheeks and skin was sewed to mucous membrane along the edges. This produced a larger mouth, as shown in Figure 36. Then we did a number of skin-graft operations, by Esser's inlay method, to free the tissues from the bone, line them with epithelium, and so restore the labial sulci. Plates were then made by the Dental School (fig. 37) and faced with pink rubber, so that the defect was much less conspicuous. Later, a mustache was added to the upper plate. (Fig. 38.) He was then able to chew solid food, and soon there was great improvement both in his physical and mental condition. The next step was to prepare tubed flaps for restoration of the lower lip, shown in Figures 37 and 39, and the improvement shown in Figure 40 was thus produced. This lip contained no muscle and did not function in eating or speaking but it did form a sulcus which controlled the

saliva and stopped the constant dribbling from the chin. It was our intention, at a later stage, to bring over flaps from the cheek and thus form an edge to the lip which would be under muscular control and thus function as a real lip.

After many preliminary operations, a double-pedicled flap was cut from the scalp to form the upper lip. This flap (fig. 41) extended across the vertex from side to side, and each pedicle contained the temporal artery of that side. This operation was followed by a recurrence of the original ulcerative condition, and the central portion of the flap became necrotic. (Fig. 42.) So we removed the necrotic portion and returned the pedicles to their original position.

At the same time that we made the scalp flap we brought up a tubed flap from the back of the shoulder to the corner of the mouth. The flap had been prepared about 10 days before, cut to pattern, and raised from its bed. It was then sewed back where it came from. (Fig. 43.) The purpose of this delayed transfer was to determine whether or not the flap had sufficient blood supply through its tubed pedicle to maintain it in its new position. This avoids failure of a flap in a conspicuous place. The blood supply of this flap proved to be sufficient, and it lived when transplated.

THE EARS

Injuries to the auricles are frequent in the Navy, and many cauliflower ears are raised in our midst. This deformity can be prevented by proper treatment in the acute stage, and many in the advanced stage can be improved by surgery. In the acute stage there is an effusion of blood between the cartilage and its perichondrium. If this effused blood be aspirated and a pressure bandage applied to prevent it from collecting again, the later deformity can be avoided.

If the blood is not removed, it is eventually replaced by fibrous tissue which contracts and produces the characteristic crumpled appearance. An incision may be made within the curve of the helix and the skin carefully raised to expose the fibrous mass. This skin is thin and closely adherent, so the dissection is a delicate one. After the fibrous tissue is exposed, as much can be removed as necessary. If the crumpled cartilage is to be straightened, a cut should be made across it from side to side, otherwise the elastic spring of the tissue will bring it back to the same shape as before operation. After suturing the wound, a pressure bandage should be applied, and if an effusion of blood does occur it should be aspirated.

I have found that the pugilists on board ship dread cauliflower ears and are glad to have anything done to prevent or correct them. The medical officer can make much character by letting the word get

around that he can prevent permanent deformities due to personal encounters.

Congenital deformities of the ears are quite common, and high social position is no bar to their occurrence. We get many requests to correct prominent ears. The incision is made in the fold between the ear and the head, and a crescent of skin is removed. This crescent should not be wide enough to obliterate the hollow behind the ear, for this gives a bad appearance, and one should not depend on the skin to hold the ear close to the head. Enough of the auricular cartilage should then be removed to allow the ear to lie close to the head, and it is desirable to remove a triangle of cartilage if it is very concave. Sutures are then passed through the cartilage and the periosteum of the temporal bone and tied. After the wound is closed a broad band of adhesive is applied, passing from the front of one ear around the back of the head to the front of the other ear, to hold them in place while healing. Figures 44 to 47 show a case of this sort.

### Tattoo Marks

Many youngsters, on their first foreign cruise, are filled with a desire for personal adornment in the form of tattooing, but as they grow older these decorations become embarrassing. Or, in the rash impetuosity of youth, they have the initials of some girl tattooed on the arm, perhaps in a heart with the words "faithful unto death." When they change girls, it is hard to explain the initials of the old love. So we have many requests to remove these marks.

Excellent articles on tattooing have appeared in the Bulletin by Captain Farenholt in April, 1908, and January, 1913. Lieutenant Hunt's article, March, 1923, gives an excellent description of the instruments and methods used.

To remove tattooing, the principal methods are caustics, electrodesiccation, and excision. The use of caustics aims to replace the pigmented area by a white scar, but the principal disadvantage of this method lies in the fact that the pigment is deposited as deep as the subsutaneous fat, and unless this is removed it will show through the scar. Also, the healing of such an escharotic wound is a long and painful process. Electrodesiccation has the same disadvantage, since it produces a burn and, if the burn is deep enough to remove all the pigment, healing is slow. Surgical removal with undercutting and sliding flaps or else free grafts is usually the best method. Each case requires some study to determine the most desirable method.

A simple linear tattoo, like that in Figure 48, may be treated by electrodesiccation or else removed surgically. In this case we removed one half at the first operation, cutting close to the line on each side of it. Two weeks later, the other half was excised in the same manner, leaving an almost invisible crescentic scar. A common type

is shown in Figure 49. Marks of this sort can be removed by cutting close to the outline of the dagger. By extensive undercutting of the adjacent skin it can be closed so that it will heal as a straight line. In this case, the drops of blood below the dagger were separately excised after the first incision had healed. In all these cases, the incision must extend through the whole thickness of the skin and the pigment in the underlying fat must be removed.

Designs like that in Figure 50, which cover a larger part of the circumference of the limb, require a different tratment. This could be removed and the flaps brought together in a ⊥-shaped wound except for the shading above the dark semicircle, which would require too much longitudinal stretching. We found it possible to approximate the edges in the upper part while the lower was filled with a full-thickness graft from the other arm. The star is a common device and is easily removed by excising it, undercutting the five small flaps and approximating their points by an intracuticular purse-string suture.

A design covering nearly half the circumference of the limb, as in Figure 51, is more difficult. The whole area may be excised, the edges undercut and stretched by tension sutures, and the remaining area covered with a full-thickness free graft. Or a vertical strip comprising about one-third of the figure may be removed and the edges brought together. A month or so later, when the skin has recovered its elasticity, another third may be removed and, at a later stage, the remaining portion may be removed without requiring any grafting.

Too much traction and stretching of the skin will not only endanger the healing of the wound but will also interfere with the circulation and cause swelling of the distal part of the limb. This is important, because in the Navy most of this work must be done without relieving the man from his duties. Circumferential stretching of the skin of the limbs is much better borne than longitudinal stretching.

### Webbed Fingers

Correction of this congenital defect is difficult, especially when, as shown in Figure 52, there is complete fusion, even to the nails. In this case there was not even a groove to indicate the line of fusion, but, fortunately, there was no synostosis. (Figure 53.) As a rule, it is better to defer the operation until the child is 5 or 6 years old, but in this case, because of a change of station, it was done at 18 months. The chief difficulty in the operation is the formation of the web and we decided to do this as a first step. Flaps were cut as shown in Figure 54, a dorsal flap running down the fingers and a shorter palmar flap with its base at the same level as the dorsal flap After the flaps were cut and raised an instrument was forced

through the tissues at the base of the flaps and the opening enlarged. The dorsal flap was then pulled through the opening and sutured in the bed from which the palmar flap had been raised. The dorsal flap was enough longer than the palmar so that it entirely covered the raw area on the palm. The palmar flap was then pulled through the opening and sutured in the dorsal raw area, only partly filling it. A strip of rubber was pulled through the opening to maintain it.

After healing occurred an incision was made down the palmar and dorsal surfaces from the tips of the fingers to the opening that had

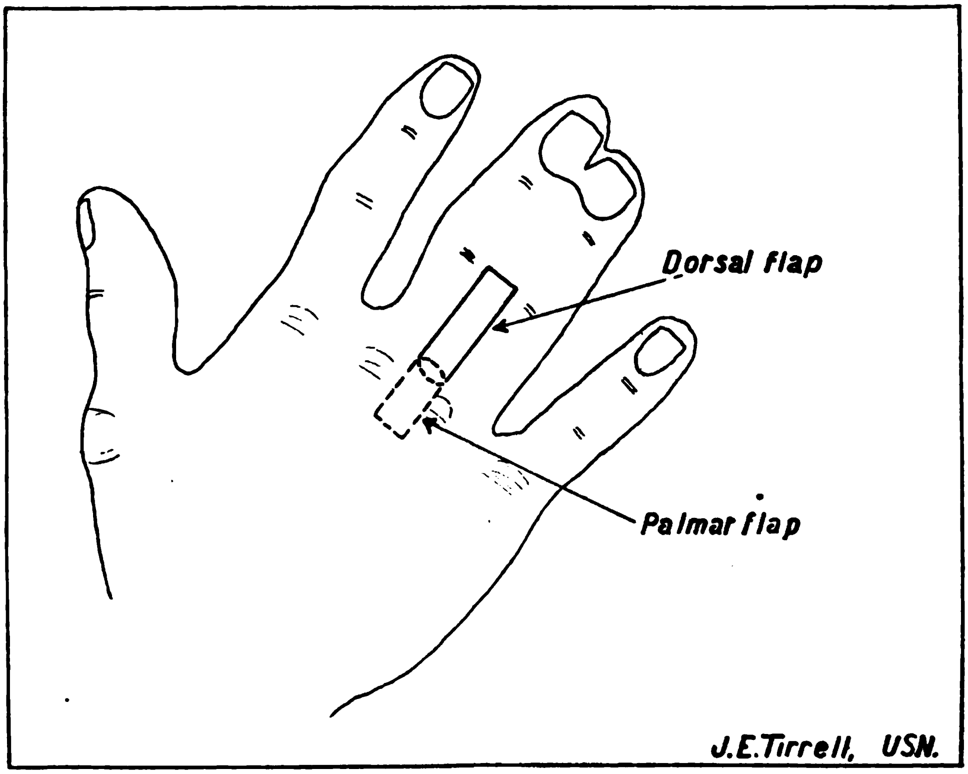


FIG. 54.—Flaps for forming web of fingers

been established by the first operation. Full-thickness free grafts were cut to a tin-foil pattern from the inner side of the upper arm and carefully sutured in the raw areas on the fingers. Healing was satisfactory and we were most fortunate in getting a smooth fold at the sides of the nails, as shown in Figure 55. A small, free graft was later necessary to complete the web.

### SUPERFICIAL NEW GROWTHS

Since a recent article on this subject,[4] we have had more than 120 cases of superficial new growths of various sorts to treat. As a result.

[4] Johnson, L. W.: Combined methods of treating malignant disease. U. S. Nav. Med. Bull., 23, 3 and 4, 1925.

we have formed rather definite opinions about the best methods of handling the different lesions.

Those which are apparently benign but potentially malignant, we remove surgically with a considerable margin of healthy tissue and submit the tissue to the pathologist. If any evidence of malignant change is found, a prophylactic course of X-ray treatment is given and the patient is told to return periodically for observation.

Basal-cell growths are destroyed immediately and radically by electrodesiccation or electrocoagulation, using the technic of Dr. William L. Clark, of Philadelphia.[4] In more than three years' experience with the high-frequency machine I have come to feel a very high regard for the electrothermic treatment of superficial malignancies. The lesion can be completely destroyed at a single treatment and the resulting scar is very slight.

Squamous-cell lesions are removed by the electrothermic method, followed by prophylactic X-ray treatment. Those which have glandular enlargement we refer to the clinic of Dr. Douglas Quick at the Memorial Hospital, New York, for radium treatment. In my visits to the various cancer clinics I have not seen any other work to compare with his. Medical officers passing through New York would do well to visit his clinic and see how much can be done in advanced cases.

Epithelioma of the lip we treat by the electrothermic method and have had some very gratifying results. This method has several advantages over surgery. There is no dissemination of the growth by manipulation and no new areas are exposed to implantation because a wall of coagulated tissue is made around the growth before the lesion itself is touched. The scarring, even from quite extensive growths, is negligible.

Routine block dissection of the glands of the neck is rapidly disappearing from favor. Less than 2 per cent of these growths metastasize below the clavicle and the glands of the neck form an important barrier to metastasis beyond them. It is not advisable to remove this barrier. If the glands do become involved, then dissection and radium implantation are advisable.

Cancers of the tongue and floor of the mouth are so malignant and so rapid in their growth that we waste no time in efforts to treat them ourselves, but send them at once to Doctor Quick's clinic. We see a number of cases with fissures at the side of the tongue and swelling of the lymphatic tissue at the base of the tongue which have been diagnosed as cancer but are not. If the patient will give up smoking

[4] Johnson, L. W.: Combined methods of treating malignant disease, U. S. Nav. Med. Bull., 23, 3 and 4, 1925.

FIG. 29.—DEFORMITY DUE TO MISPLACED FLAPS AFTER LACERATED WOUND OF LIP

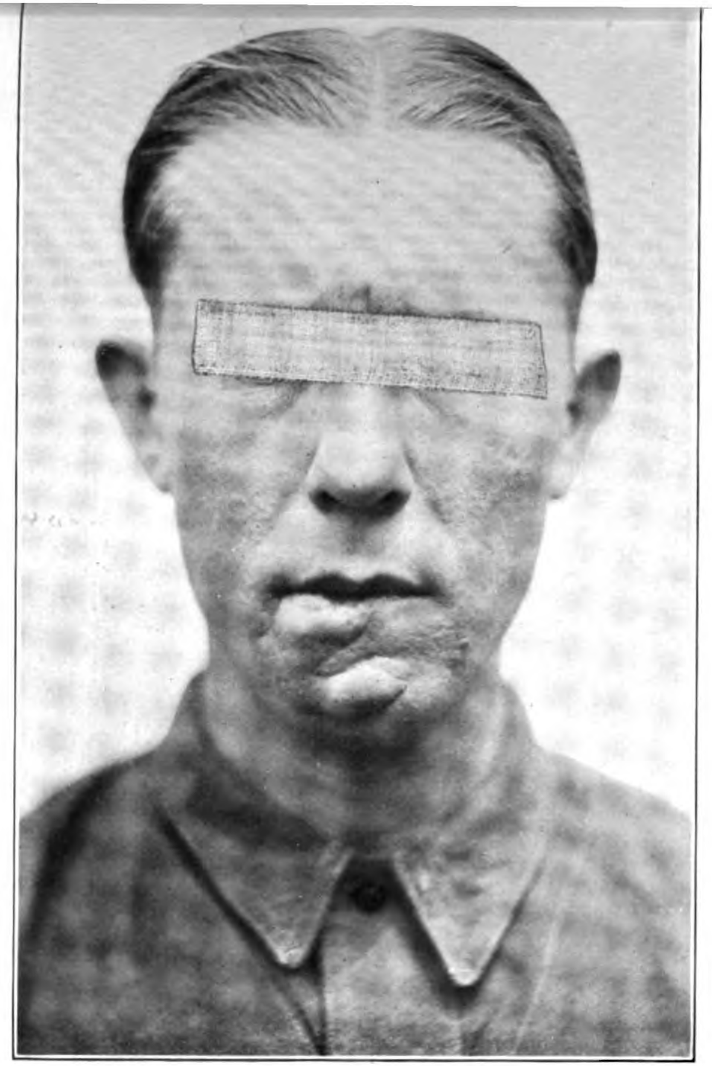

FIG. 32.—SHOWS IMPROVEMENT SOON AFTER OPERATION. SOME EDEMA STILL PERSISTS

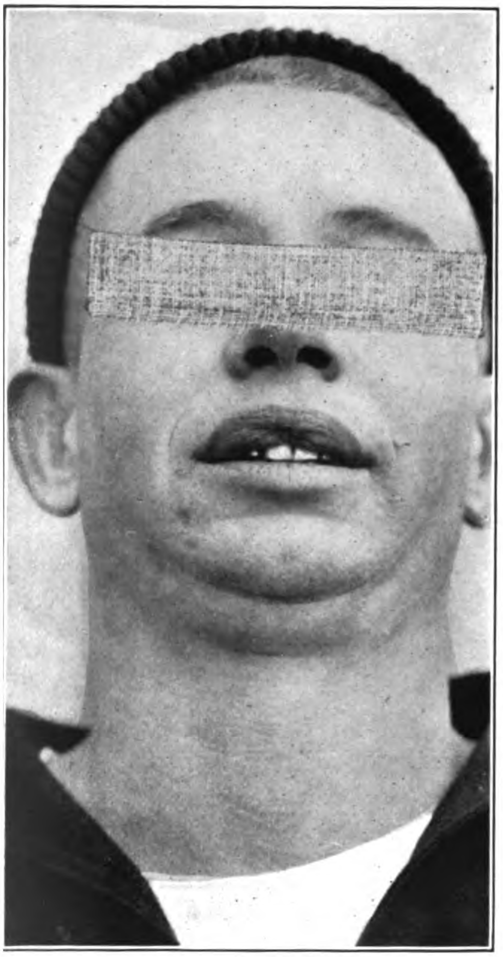

FIG. 33.—DOUBLE LIP

FIG. 34.—DOUBLE LIP AFTER OPERATION

FIG. 35.—LOSS OF LIPS AND COLUMELLA THROUGH DISEASE. RANGE OF MOTION OF JAW LESS THAN ONE-HALF INCH

FIG. 36.—AFTER OPERATION TO INCREASE SIZE OF MOUTH

FIG. 37.—DENTAL PLATES MADE AFTER OPERATIONS TO RESTORE LABIAL SULCI. NOTE TUBES PREPARED FOR FLAPS

FIG. 38.—DENTAL PLATES WITH MOUSTACHE ON UPPER

FIG.—39.—TUBED FLAP FROM CHEST APPLIED TO LOWER LIP

FIG. 40.—LOWER LIP FORMED BY TUBED FLAP FROM CHEST

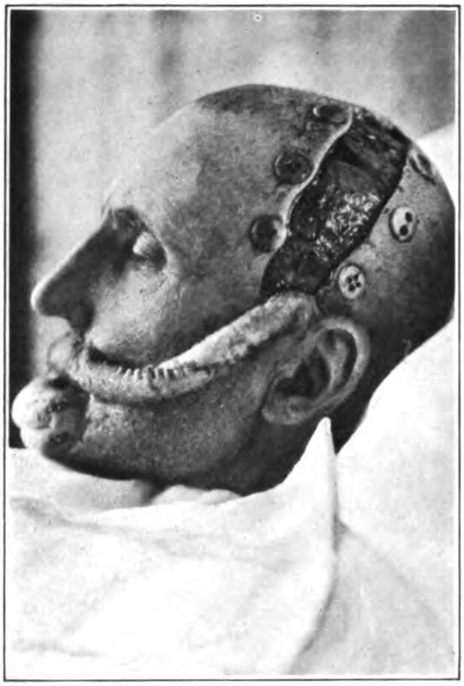

FIG. 41.—DOUBLE-PEDICLED SCALP FLAP FOR RESTORATION OF UPPER LIP

FIG.—42. DOUBLE-PEDICLED SCALP FLAP FOR RESTORATION OF UPPER LIP. TUBED FLAP FROM BACK TO THE LOWER LIP AT THE ANGLE OF THE MOUTH

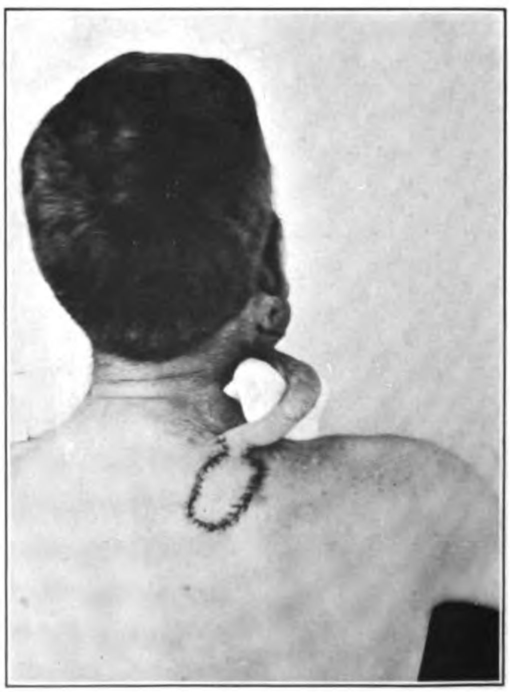

FIG. 43.—DELAYED TRANSFER OF TUBED FLAP. THE FLAP HAS BEEN CUT AND RAISED, THEN SUTURED BACK IN PLACE TO DETERMINE ITS BLOOD SUPPLY

FIGS. 44 AND 45.—PROMINENT EARS BEFORE OPERATION

FIGS. 46 AND 47.—PROMINENT EARS AFTER CORRECTION



860—5

FIG. 48.—A STAR TATTOOED ON THE SCALP IN YOUTH BECAME CONSPICUOUS AS THE HAIR RECEDED. NOTE SCAR FROM EFFORT TO REMOVE IT BY CAUSTICS

FIG. 49.—A COMMON TYPE OF TATTOO

FIG. 50.—TATTOO OF WRIST. TREATED BY EXCISION AND GRAFTING. NOTE STAR AT BASE OF THUMB


FIG. 51.—A TATTOOED DESIGN COVERING NEARLY HALF THE CIRCUMFERENCE OF THE LIMB

860—6

FIG. 52.—EXTREME DEGREE OF SYNDACTYLISM WITH FUSION OF THE NAILS

FIG. 53.—RADIOGRAM OF WEBBED FINGERS SHOWING ABSENCE OF SYNOSTOSIS

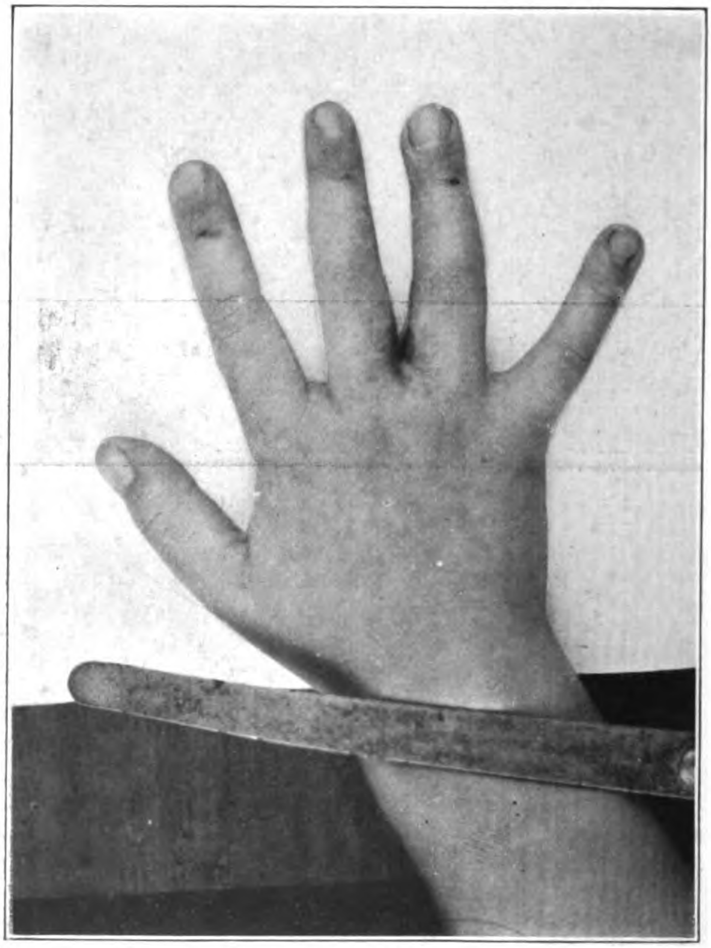

FIG. 55.—AFTER OPERATION FOR WEBBED FINGERS

860—8

and have the mouth cleaned, most of these will heal; but, if they persist, the patient should be examined by someone who is competent to say whether or not the condition is cancer.

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## THE PHYSICAL EXAMINATION FOR FLYING WITH SPECIAL REFERENCE TO THE EYES

By JOHN C. ADAMS, Lieutenant Commander, Medical Corps, United States Navy

During the past two or three years aviation has assumed a position in the public mind probably greater than any other one subject. Its progress in this respect has advanced amazingly. From a military standpoint, and particularly in the Navy, we have become included in this great advancement. Upon the conclusion of the investigation by Congress, and with the recommendation of the Morrow Board on aviation, legislation was passed which gave the Navy a definite building program for planes and a very definite increase in the number of aviators and chief aviation pilots, the latter to be derived from the enlisted branch of the service.

To meet this authorized expansion in aviation personnel, the demand for aviation physical examinations has increased tremendously. Owing to the large percentage rejected for physical reasons, and the small percentage of those physically qualified who successfully pass the course of training at Pensacola, it has become a serious problem to provide the necessary candidates for training. Large numbers are examined, but only a small percentage are accepted in the end. As an example of what demands this branch of the service has made upon the Medical Department, there were 855 examinations for flying completed at the air station at San Diego in the year 1927, whereas in January and February of 1928 there was a total of 403 for the two months. When one stops to consider the extent of an aviation physical examination and the limited number of medical officers performing this work, a more comprehensive idea of the task confronting us may be had.

It is estimated that about 45 per cent of the candidates appearing for examination are rejected for physical or psychological reasons, and, according to Benjamin (1), only 51 per cent of those physically qualified have successfully passed the course of instruction at Pensacola during the preceding five-year period. Indeed this figure appears high when compared with only 35 per cent who passed the course at Pensacola during the past year. The Army, in reviewing 1,000 cases (2), found that 23 per cent had been rejected physically. This, however, was in 1918, which may account for the difference as applied to the Navy percentage.

In reviewing the results of 361 ensigns examined at this station during the past year it is found that 42 per cent were rejected physically or psychologically and that only 88, or 24 per cent of the number, were found qualified for solo flying at the conclusion of their 10-hour period of instruction.

In a more detailed study of the results of the last 150 ensigns examined it was found that only 74, or 49 per cent, passed the physical examination. Of the 76 who were rejected, the eyes were at fault in 62 per cent of the cases. Of the faulty eyes, muscular imbalance was one of the causes of rejection in 26 per cent of the cases. As a further indication of the lack of physical fitness in the rejected group, there was a single disqualifying defect in 19 cases; there were 2 disqualifying defects in 18 cases; 3 defects in 28 cases; and 4 or more disqualifying defects in 11 cases.

Such a disastrous outcome is hard to associate with a group of young officers so recently graduated from the academy. It would seem, indeed, that, following the rigid requirements for appointment to the academy, as well as the examination upon graduation, together with the favorable athletic environment during their period of instruction, these young officers should give us our greatest per cent of acceptable candidates. It appears that the difficulty lies largely with the eyes, 62 per cent of this group being disqualified on this score, as well as for other possible causes.

The fact remains that we are confronted with an expansion in aviation personnel, and that the rejections for physical reasons are a serious factor in the task of supplying the necessary number of condidates for training. This has led to the very serious question of whether our physical requirements were not possibly a bit severe along certain lines and therefore the cause of the rejection of a very considerable percentage of otherwise desirable candidates. Our own bureau has assumed an unprejudiced attitude on this subject, and though insisting on a proper physical standard has increased the limits on certain of the requirements called for in the examination. Despite these increased allowances and the very practical attitude of the bureau in regard to the waiver of certain minor defects the examination still remains one of the most exacting routine physical examinations known to-day, and disqualifies a large percentage of candidates.

It is with this fact in mind that an attempt has been made to determine what phase of the examination proves the most difficult to pass and whether there were further possibilities of broadening these requirements to meet the more practical demands of the service.

As has been determined, the eyes figure as a source of rejection in 62 per cent of the disqualified cases. The Army, in a study of

1,000 examinations (2), estimates the eyes as a source of rejection in 50 per cent of those disqualified. In considering this great source of defects it is well first to consider the standards required in our examination of the eyes before reaching other conclusions. These requirements may reasonably be divided into the determination of the manifest defects of the eye and the latent or hidden defects. We require normal visual acuity—that is, a minimum of 20/20 for each eye—and for a flyer beginning a career in aviation it is believed to be reasonable. We require normal color perception, which is certainly important in determining the type of his terrain, running lights, modern spotting, etc. Normal stereoscopic vision is required—a matter of importance in correct landings, and, of course, anatomical defects that interfere with the proper function of the eyes are a source of rejection. Roughly speaking, any deficiency in the above requirements is considered as a manifest defect and should be a cause of rejection.

Of the latent or hidden defects of the eye, we have many which are cause of rejection. For instance, we refract the eyes and determine the true correction. A latent hyperopia that requires more than one diopter of correction to enable the subject to read 20/20 is considered as an eye strain. Because of the known tendency for hyperopia to increase with age and extra work, this is sufficient cause for rejection. A low accommodation and a low angle of convergence are also taken into consideration, and, if sufficiently low, are indicative of a poor reserve, a poor risk, and are causes for rejection. We then determine the strength of the extrinsic muscles of the eyes, to see if there is a reasonably normal muscular balance of the eyes. This phase of the examination is especially important. We know that in order to have binocular single vision the eyes must move and focus in perfect unison. When this is not so, when the eyes do not move in the same relation to each other, we have squint and double vision, which, of course, would be a manifest defect and cause of rejection. However, merely because we are not all cross-eyed does not imply that our eyes are in muscular balance. Many of us have a tendency to squint, due to latent or hidden muscular imbalance, and it is this hidden tendency, or heterophoria, that we look for in the aviator. If his external rectus muscles are the strong ones the eyes tend to deviate outward, and this defect we call exophoria, a great source of trouble and cause for rejection. If it is the internal recti that are strong, the eyes tend to deviate inward, convergent squint, and we call this condition esophoria. If one eye tends to deviate upward, we then are dealing with hyperphoria.

It is because these hidden or latent defects of muscular balance tend to increase under the influence of eye strain, fatigue, and lack

of oxygen, or anoxemia, that they become important to us in passing upon one's qualifications to fly. According to Bauer (3), muscular imbalance is a serious source of danger to the flyer, and the Army (2) considers exophoria and hyperphoria of grave importance, because of the very conditions met in flying. In this connection the Army subjected a number of candidates to anoxemia by placing them on the rebreather, and again in the low-pressure chamber, and determined the muscular balance at an altitude of 5,000, 10,000, 15,000, and 20,000 feet with the following results, to quote:

In all the subnormal subjects examined, particularly those with convergence insufficiency alone or combined with divergence excess (exophoria), there was a marked loss in the power of adduction, and diplopia often occurred between 10,000 and 15,000 feet. Men with over 1° of hypophoria, particularly when combined with exophoria, showed a rapid reduction in muscle strength, often resulting in diplopia, etc."

Again quoting:

It is important for the flyer that his muscle balance be as nearly normal as possible, for small defects are accentuated by the strain of flying and lack of oxygen, resulting in a marked contraction in the field of binocular single vision, and sometimes diplopia is produced even at low altitudes. Research work has demonstrated that exophoria and hypophoria are more objectionable than esophoria.

It is an easy thing to see that for the same reason that a poor heart, while capable of complete compensation at sea level, is apt to develop embarrassment at high altitudes due to the general effect of anoxemia, a weak eye muscle is likewise impaired in its power to function, thus permitting its opposed muscle, which may be much the stronger, to take full control of the eye and induce a deviation to that side, with, of course, a resulting diplopia.

While realizing the true significance of muscular imbalance and in particular the more common form, exophoria, it was decided, if possible, to throw further light on the subject by determining what effect flying over a number of years had on the muscular balance of the eyes. So far as could be determined no information of this kind is now available in the literature. To obtain this information, 100 aviators on duty in this vicinity were selected, and the aviation section in the Bureau of Medicine and Surgery was requested to supply the entry pertaining to esophoria, exophoria, angle of convergence, and date of examination in the case of each subject, as noted on the original physical examinations filed in the bureau at the time of the candidate's entry into aviation. These original entries were then checked against the findings as determined on the annual physical examination for 1928. The facts which follow were disclosed.

Concerning the method of determining the muscular balance, an ordinary rotary prism mounted in a phorometer frame is used.

Esophoria or exophoria, as the case may be, is determined at a distance of 6 meters and again determined for the near point of 33 centimeters. The Navy allowances at 6 meters provides for (*a*) esophoria of not more than 4 D. plus less than 4 D. of prism divergence, or plus a diplopia in the lateral positions, or plus a high hyperopia, or (*b*) not more than 10 D. of esophoria alone. For exophoria, more than 2 D. disqualifies, if associated with a low angle of convergence, or plus a diplopia in lateral positions, or if there is more than 5 D. alone. At 33 centimeters exophoria of more than 12 D. disqualifies. Hyperphoria was not considered in this study.

Of the group of flyers studied in this series, 32 per cent have flown since 1923, 35 per cent since 1924, and the remainder since 1925.

On the original examination, 54 per cent showed no esophoria at 6 meters; 85 per cent, however, showed exophoria at 33 centimeters, 37 per cent of whom also showed an exophoria at 6 meters. Twenty-four per cent had an angle of convergence of less than 50° (40° being the lower limit), and of this group exophoria was present at 6 meters in all but five cases.

As to the effect of flying, considering the group as a whole, 49 per cent show an increase of more than 2 D. in exophoria. Nineteen per cent of the whole show 4 D. or more increase in exophoria and 12 per cent have gained 7 D. or more. Exophoria has exceeded the allowance of 12 D., necessitating waiver in 7 per cent of the cases. There are 10 per cent who show a decrease in their exophoria without any gain in their esophoria. Esophoria, on the other hand, has not exceeded the allowance in a single case. Of the group showing original esophoria, only five cases have gained more than 2 D. Two show a gain of 6 D., two gained 5 D., and one gained 3 D. The changes in this group were without significance as applied to the other associated findings, possibly because of the small number showing a gain in esophoria. In 4 per cent of the total group the findings were opposite to the rule—i. e., there was more exophoria at 33 centimeters than at 6 meters.

Again, considering the 85 per cent who showed exophoria on the original examination, 53 per cent had 4 D. or more on original examination; 12 per cent had 8 D. or more; and 12 per cent had as much as 10 D. or more of exophoria. Of the 12 per cent who had 10 D. or more of exophoria originally, 52 per cent have remained stationary or slightly decreased, while 42 per cent have increased 2 D. or more. There are 13 per cent of the whole group whose exophoria has reached the maximum allowance or exceeded it. Of this group, three-fourths of the number had an original exophoria at 6 meters and half of the number had an angle of convergence of less than 50°. Of the group of 49 per cent showing more than 2 D.

gain in exophoria, there was an increase in the angle of convergence of 3° or more in 57 per cent of the cases. This is distinctly contrary to what would be expected, and the only explanation that can be suggested is that of increased innervation which, when measured under volitional demands gives us a closer P. C. B., while under the phorometer it becomes measured in terms of passive strength or exophoria.

While, possibly, a study of such a limited number of cases may be considered small, yet it is certainly not without significance. One is impressed with the fact that exophoria is by far the more common form of muscular imbalance. Exophoria remained stationary in only 27 per cent of the cases and increased more than 2 D. in 49 per cent of the cases, the gain being 7 D. or more in 12 per cent. It has reached the limit, or exceeded it, in 13 per cent of the group, and waivers have been required because of this defect in 7 per cent of the cases. Esophoria, on the other hand, seems to give little trouble. Only a small percentage show a material gain in esophoria, and in no case has waiver been required or the limits exceeded. We find, then, that the original opinions expressed concerning the seriousness of exophoria are fairly well borne out by the changes produced as a result of flying.

In considering the trend toward increase in exophoria associated with flying, it was decided to determine, if possible, what the dominant factor could be in flying that would increase this muscular imbalance. Naturally the goggles were taken into consideration. They were examined for optical defects. A group of pilots were checked on the phorometer with the goggles in position and with them off, but in every case there was less than one-half D. variation in their readings, so that this possible cause was rejected. Turning, however, to the restricted field of vision that the aviator encounters in flying, and associating this with the use of goggles, it is believed that the explanation has been found.

In flying the aviator is forced to look to either side of his ship, forward vision is almost completely blocked, due to the upper wing and the motor. His forward vision is, therefore, at a tangent to the plane. Further, in keeping position in formation, and in flying in general, he has to keep a sharp lookout. He is unable to rotate his body to any appreciable degree in looking to the extreme sides and backward, as we may do by facing about, but is forced to depend upon the extreme rotation of his head and maximum deviation of the eyes to either side. In conjunction with these visual demands, he wears goggles which consist of two lenses, one for each eye, connected by a framework across the bridge of the nose. The goggles

are fringed with padding to prevent leaks, but the padding also greatly adds to the normal obstruction by the bridge of the nose which is encountered in extreme binocular lateral vision. The lenses of the goggles extend from just forward of the anterior surface of the eye to an extreme lateral position, thus inviting maximum visual acuity in the lateral fields. Under such circumstances the eye on the engaged side is free to deviate to extreme lateral positions with good vision, but the other eye, on the disengaged side, in attempting to follow through the movements of its brother, is able to do so and maintain binocular single vision only until it meets with the screen or block at the nose, due to the rim of the frame of the goggles resting against the inner canthus of the eye and nose. From this time on vision is blocked for this eye, and the tendency is for it to lag in its further adduction, or possibly swing back to a more neutral position. It can be seen then that maximum use can always be made of the external rectus muscles in obtaining lateral vision, which is the common visual habit of the flyer, whereas maximum exertion of the internal rectus muscles is never required; indeed, they are encouraged to lag in almost every instance. As one pilot expressed the problem, he knew something had changed about his eyes since he began flying, because when leading a formation of planes he is now able to see the plane to the side and back of him without turning his head.

Summarizing our problem on the physical examination, we are confronted with a rejection of almost 50 per cent of the candidates for physical reasons. The defects of the eye are a source of rejection in over 50 per cent of these cases. In a study of the eye requirements it appears that for the present, so far as the manifest defects of the eye are concerned, the requirements should not be changed. Among the latent defects muscular imbalance is the chief source of rejection. Exophoria is by far the most common of these defects. Exophoria tends to increase with flying and the present limits of the examination requirements should not be increased. It is believed the increase in the allowance of hyperphoria to 0.75 D. is the maximum consistent with safety. Esophoria is not a serious source of trouble and is cause for few rejections. It is believed that little would be gained in increasing its allowance.

As to latent hyperopia, it is believed that 1.50 D. may be safely allowed as a routine measure, provided it is not associated with esophoria or exophoria near the disqualifying limits, or accommodation that is excessively low. Few cases are rejected for latent hyperopia, and each case should be considered with reference to the other associated findings.

An angle of convergence below 40° should continue to be cause for rejection if associated with more than 7 D. of exophoria at 33 centimeters. It is believed that an angle below 40°, but above 35°, is consistent with safety, provided it be associated with less than 8 D. of exophoria at 33 centimeters. The angle of convergence tends to hold or increase with flying.

The present allowance for accommodation is believed to be ample. The present requirements for color preception and stereoscopic vision should be maintained.

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# PHYSIOLOGY OF THE VEGETATIVE CENTERS[1]

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## DIENCEPHALON

### Anatomy

The diencephalon is that part of the prosencephalon which corresponds in a large measure to the third ventricle and the structures which bound it. Above and in front the diencephalon is connected with the cerebral hemispheres, and behind it is connected with the mesencephalon. The corpus callosum conceals its upper surface, while it is covered by a fold of pia mater termed the tela chorioidea of the third ventricle. Its inferior surface, which forms the principal anatomic part of this paper, reaches to the base of the brain.

The diencephalon is formed of the thalamencephalon, the pars mamillaris hypothalami, and the posterior part of the third ventricle. For descriptive purposes, however, the whole of the third ventricle is commonly accepted as belonging to the interbrain. It makes it much more convenient to accept the whole of the third ventricle instead of just the posterior part. Structures, such as the pars optica hypothalami, and the corresponding part of the third ventricle, which

[1] Read before the medical staff of the U. S. Naval Hospital, Brooklyn, N. Y., September, 1927.

properly belong to the telencephalon, must necessarily be included in the description of the interbrain.

The thalamencephalon comprises (*a*) the thalamus, (*b*) the metathalamus or corpora geniculata, (*c*) the epithalamus, consisting of the trigonum habenula, the pineal body, and the posterior commissure.

The thalami are two large ovoid masses situated on either side of the third ventricle and reaching for some distance behind that cavity. They really form the lateral walls of the ventricle. The thalami are connected medially by a flattened, gray band, measuring about 1 centimeter in its anteroposterior diameter, called the massa intermedia, or middle commissure.

The lateral surface of the thalami is bounded by a mass of white substance known as the internal capsule, which separates it from the lentiform nucleus of the corpus striatum.

The inferior surface rests upon the upward prolongation of the tegmentum. The thalami receive most of the fibers from the tegmentum and may be considered the tegmental continuation.

The nucleus thalamus is almost entirely composed of gray substance. It contains some white fibers also. There are a great number of nuclei strewn within the substance of the thalami, which act as synapses of impulses coming from the periphery, and which give origin to fibers extending to the cerebral cortex.

The meta- and epithalami are hardly concerned in the subject matter of this paper, so we shall pass them by.

In the hypothalmus are included the subthalamic tegmental region and the structures which go to form the greater part of the floor of the third ventricle, namely, the optic chiasm, the hypophysis, infundibulum, tuber cinereum, and corpora mammillaria.

Gray states that the subthalamic tegmental region consists of the upward continuation of the tegmentum; it lies on the ventrolateral aspect of the thalamus and separates it from the fibers of the internal capsule. The red nucleus and the substantia nigra are prolonged into its lower part; in front it is continuous with the substantia innominata of Meynert, medially with the gray substance of the floor of the third ventricle.

It consists, from above downward, of three strata: (1) Stratum dorsale, directly applied to the under surface of the thalamus, and consisting of fine longitudinal fibers; (2) zona incerta, a continuation forward of the formatio reticularis of the tegmentum; and (3) the corpus subthalamicum (nucleus of Luys), a brownish mass presenting a lenticular shape on transverse section, and situated on

the dorsal aspect of the fibers of the base of the cerebral peduncle; it is encapsuled by a lamina of nerve fibers, and contains numerous medium-sized nerve cells, the connections of which are as yet not fully determined.

The corpora mammillaria (corpora albicantia) are two round, white masses. Each one is about the size of a small pea. They are located a little below the gray mass of the floor of the third ventricle, in front of the posterior perforated space, and are formed of white and gray substance. The gray is formed of masses of nuclei, from which fasciculi arise and pass into other parts, while fasciculi coming from other regions end within its cells.

The tuber cinereum is a hollow eminence of gray substance situated between the corpora mammillaria behind and the optic chiasm in front. Laterally it is continuous with the anterior perforated substance, and anteriorly with a thin lamina, the lamina terminalis. From the under surface of the tuber cinereum a hollow conical process, the infundibulum, projects downward and forward and is attached to the posterior lobe of the hypophysis. In the lateral part of the tuber cinereum is a nucleus of nerve cells, the basal optic nucleus of Meynert, while close to the cavity of the third ventricle are three additional nuclei. Between the tuber cinereum and the corpora mammillaria a small elevation, with a corresponding depression in the third ventricle, is sometimes seen. Retzius has named it the eminentia saccularis, and regards it as a representative of the saccus vasculosis found in this situation in some of the lower vertebrates (Gray). There are a large number of cells contained within the tuber cinereum which have not, as yet, been differentiated with certainty. Clinical and experimental pathology point with considerable probability to differentiated nuclear cells governing different physiological functions being located there. Nucleus tuberis, n. paraventricularis, n. paramedianus, n. reuniens, may be mentioned as some of the nuclei which have assumed considerable importance of late in experimental pathology.

The infundibulum, which projects as a hollow, conical process from the under surface of the tuber cinereum and is attached to the posterior lobe of the hypophyseal gland, is practically a projection of the gray substance forming the floor of the third ventricle. It contains numerous nerves and cells found in the same substance higher up in the brain. While certain physiological function is attributed to the cellular nuclei apparently located there, and while a considerable mass of data has been collected to substantiate the hypothesis, yet it must be admitted that nothing definite has been established.

### Physiology

The gray substance about the third ventricle, especially the hypothalamus, either directly governs, or at least influences, the following functions:

1. The innervation of the smooth musculature of the eyes.
2. The contractions of the bladder and uterus.
3. Regulation of temperature.
4. The vasomotility and the sweat, tear, mucous, and sebaceous secretion.
5. The water, carbohydrate and albumin metabolism.
6. The trophic influence on skin and its underlying fat.

#### Diencephalon and the smooth musculature of the eyes

Karplus and Kreidl were among the first investigators to point out the value of the diencephalon as a cerebral center for vegetative functions. They succeeded in observing a maximum pupillary dilatation in cats and dogs, as well as a tearing open of the lid space and sinking back of the inner lid in the same animals through electric stimulation of the base of the brain lateral from the infundibulum. Further investigations disclosed a sympathetic center for the smooth musculature of the eyes located in the frontomedial part of the corpus subthalamicum. This localization seems to receive stimulations from the cerebral cortex. Karplus and Kreidl appeared also to get definite sympathetic responses of the eye, although not regularly, when electrically stimulating the frontal pole.

These same investigators could further show that the sympathetic pain reflexes to the eye do not necessarily pass by way of the cerebral cortex. When they electrically irritated the sciatic nerve in a cat, after they had removed the cerebral cortex, they could distinctly see the cat's pupils dilate. The same observation was also made after the removal of that part of the cortex lying frontal from the corpus subthalamicus. If, however, that part of the brain was removed so that only the caudal part of the subthalamic region remained, there were no pupillary reflexes to be observed in response to sciatic irritation.

As a result of these experiments, it might be fair to assume that pain nerve stimulations are conducted to the thalamus, and from there a part of the stimulation is carried to the cortex, where it is brought to the consciousness, and part is relayed to nuclei in the diencephalon, where it stimulates sympathetic vegetative centers bringing about the well-known symptoms which usually accompany sensations of pain. In addition to the pupillary changes there are

also influences exerted on the vasomotility, perspiration, increase of cardiac action, as well as contraction of the bladder.

Nussbaum observed bladder contractions in response to irritations of the diencephalon, even after removal of the cortex, but these disappeared after severing the pedunculi. Lichtenstern considers the hypothalamus the cerebral center for bladder contractions. The center sends, through the spinal cord, the sympathic ganglia, and the plexus hypogastricus, inhibitory impulses, and, through the nervi erigentes, impulses promoting contraction of the musculature of the bladder. Karplus and Kreidl also observed contraction of the bladder in their experiments on interbrain stimulation. According to their findings, the center controlling contractions of the smooth muscles of the bladder should be in the hypothalamus, in all probability in the corpus Luysii.

The investigations of Bechterew would indicate that it should be possible to influence both inhibitory and accelerator impulses upon the uterus from the forepart of the thalamus, while B. Aschner observed contractions of the pregnant uterus and rectum on stimulating the floor of the third ventricle.

## DIENCEPHALON AND TEMPERATURE REGULATION

Far more important than the influence upon the smooth fibers of the eye, the bladder, and the uterus is the regulation of warmth from the diencephalon. That there is a center in the diencephalon for the regulation of temperature, has been fairly well established by Isenschmidt. The findings of Isenschmidt would place the center in the tuber cinereum, and in a nucleus located in the anterior part, in a region localized anywhere from one to several millimeters lateral from the center.

Up to the time Isenschimdt used his exclusion methods, injuring the tuber cinereum or irritation methods were employed with the fond hope of locating the temperature-regulating centers. Aronson and Sachs could induce hyperthermia through their methods of injury to the corpus striatum. Injury to the basal ganglion in other regions, as practiced by Ito, Girard, Aisenstat, and Sachs, gave the same results. From the results of these experiments we can hardly avoid drawing conclusions that perhaps the heat center is really located in the tuber cinereum and that impulses from other cerebral parts are conveyed to it. H. H. Meyer remarked that the temperature-regulating center must not be conceived as one center but rather as composed of two centers, one which raises the temperature and the other which lowers it; one is of a sympathetic and the other of a

parasympathetic nature. It could be demonstrated that typical sympathetic poisons (tetrathydronaphthalinum, adrenaline, cocaine, ephedrin, and caffeine) cause a rise in temperature, while poisons which influence the parasympathetics (pilocarpine, picrotoxin, santonin, aconitine, veratrine, digitalis) lower the temperature. Further, it has been demonstrated that the sympathetic system influences metabolic changes, with the liberation of warmth, while stimulation of the parasympathetics have a tendency to bind heat. H. H. Meyer draws conclusions from the foregoing inference that a sympathetic center governs the heat raising and a parasympathetic center governs the heat lowering.

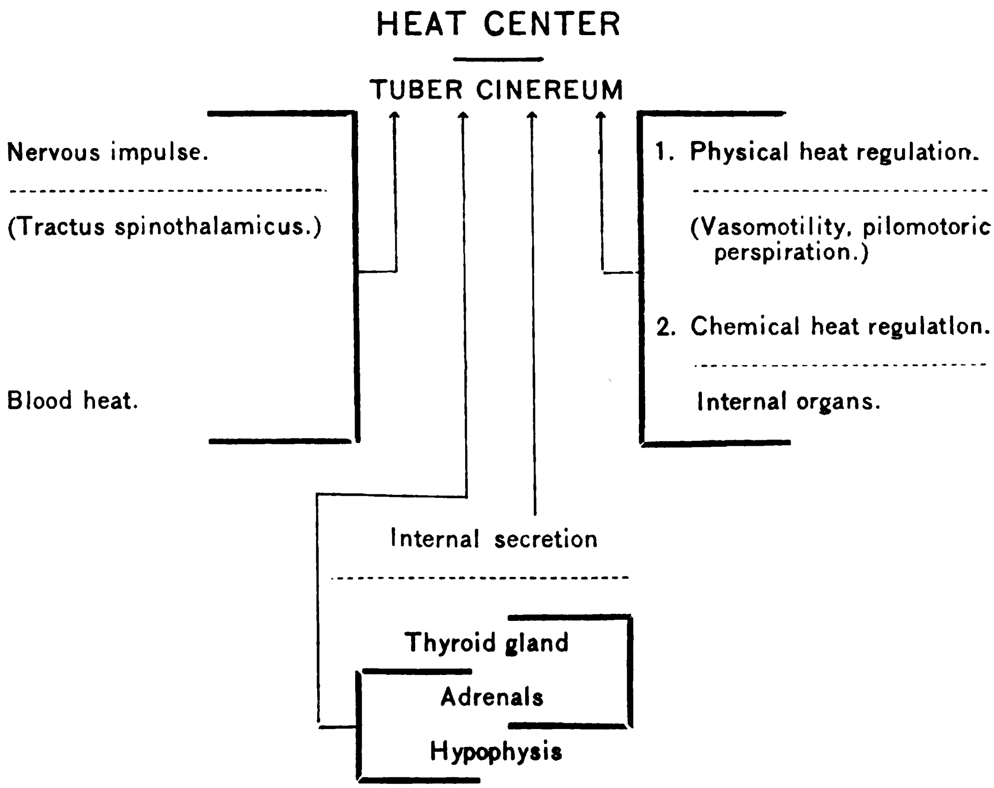
The peripheral organs through which bodily warmth is regulated are the blood vessels, the perspiratory glands, the pilomotor, and the internal organs. Another influence, of no mean importance in the regulation of bodily heat, is exerted by the organs of internal secretion. It has been observed that their secretion or hormone influences metabolism so that an increase or decrease of warmth arises. In spite of the almost countless processes, within and without, influencing the temperature, bodily heat remains practically stationary in healthy people. And just because bodily warmth hardly varies one tenth of a degree in those enjoying good health, no matter what the influence may be, one must assume the existence of a center directly governing its regulation.

The regulating center is kept constantly informed of the conditions prevailing, either via peripheral nerves in the skin, the nerve tracts, or the blood stream. The stimulation affecting the peripheral nerves of the skin is carried to the medulla spinalis, whence it is further conveyed by the tractus spinothalamicus to the optic thalamus. From the nucleus of the thalamus, a part is conveyed to the cerebral cortex, where it is brought to the consciousness of the individual, and a part to the heat center in the hypothalamus where it exerts its regulatory reflex.

The blood stream, in all probability, plays the more important rôle in the regulation of temperature. R. H. Kahn's experiment showed very well that warming the blood stream passing through the carotid to the brain produced dilatation of the blood vessels of the skin, perspiration, and heat dyspnea, physical reactions of overheating. Barbour and Hashimoto introduced small tubes into the brain through which water of various degrees of temperature was conducted. By passing cold water through the tubes they obtained an increase of bodily temperature, and passing warm water through the tubes into the brain produced a decreased bodily temperature.

The blood, then, might be considered the principal physiological stimulant for the temperature-regulating center located in the brain.

R. Greving published the following table, which gives a very clear conception of the rôle which the tuber cinereum plays in the scheme of regulation of the body temperature:




As a result of an affection of an organ or organs taking part in the bodily warmth regulation, a disturbance of the heat balance takes place. Usually the change manifests itself in fever. Subnormal temperatures also occur. The majority of fever-producing poisons attack the heat centers directly. Mechanical, chemical, and chemico-physical experimentation upon animals with irritants frequently produced an increase in temperature. Ott injured the interbrain; Jakoby and Roemer dropped mercury into the infundibulum; Waldbaum touched the ventricular wall with carbolic acid and silver nitrate, causing a rise in temperature. These experiments go a long way toward explaining the rise in temperature in disease or injury of the brain substance near the heat center (tuber cinereum) in which there does not exist an infection. Only in such manner can a rise in temperature that has been observed in sclerosis of the basal ganglia, in hydrocephalus internus (Mammele), in hemorrhages into the third ventricle, in increased cerebrospinal pressure (Reichardt), and in a case of an acoustic tumor which the writer recently observed—temperature going to 109° F just before death—be accounted for. In similar manner can fever be accounted for in cases of apoplexy. Resorption has most frequently been blamed in apoplexy

for the increased temperature. While undoubtedly resorption plays an important part, pressure upon the gray matter in the hypothalamus unquestionably exerts a powerful influence also. Or perhaps a part of the fluid breaks through into the third ventricle, distending its walls, and in this manner produces a mechanical irritation of the heat center, very similar to that produced by the mercury which Jakoby and Roemer dropped into the infundibulum.

Subnormal temperatures have also been observed in hydrocephalus, as in the case which Stettner reported. In this instance a paresis of the heat regulating centers probably occurred. Tension upon the walls of the third ventricle was probably the cause. It has been observed that decrease of intraventricular pressure through puncture, in cases where fever existed because of intraventricular pressure, was followed by a regulating response to the heat center.

Most often toxic irritants are responsible for the increases of bodily temperatures. They, in all probability, attack the centers directly. In that manner it is quite possible to account for the fevers occurring in infectious diseases. The causative agents may be the infectious bacteria or their toxins produced in the breaking down of the albumins attacking the center.

However, we wish again to direct attention to the fact that the cerebral center, important as it is, is not the sole agent in regulating the bodily temperatures. In the table shown at another place the other organs responsible for the heat regulation are pointed to. This paper being a discussion of the central heat-regulating center, particularly about the diencephalon, we can not devote much time to a résumé of the literature and experiments dealing with influences of the bodily heat regulation other that the cerebral, and therefore we shall confine the discussion principally to the brain.

### Interbrain and Vasomotility, Perspiration, Lacrimation, Salivation, and Sebaceous Secretion

Karplus and Kreidl observed in their experiments upon the corpus subthalamicus (corpus Luysii) oculo-pupillary symptoms and general vasoconstriction. The experimental observations of Schrottenbach bore out their observations. In the light of these facts it would be quite natural to attempt to place the vasomotor center in the hypothalamus (corpus Luysii). This would harmonize quite well with what we have learned in reference to the heat-regulating center. The old literature mentions an influence on the heart and vasomotor system coming from the thalamus.

Just as we admit a probable center for the vasomotility, so we are obliged to accept a possible higher center for perspiratory secretion. The center is perhaps also located in the interbrain. Karplus and Kreidl noticed profuse perspiration on all four paws of the animal in their experimental irritation of its interbrain.

Salivary and lacrimal secretion has also been observed as a result of irritating the regio subthalamica. The vegetative tracts, which influence these functions, must, of necessity, also have a higher center located in the interbrain.

There are a number of clinical records to substantiate these experimental data. Schrottenbach reported an apoplexia with a paralysis of the left half of the face, left spastic paresis, loss of sensibility of the left half of the body, combined with secretory disturbance, with marked injury of the vasomotors of the left side. In one of Gerstmann's cases, a patient suffering from a gunshot wound of the brain, a sympathetic ophthalmoplegia (contracted pupil and contracted palebral fissure) on the right side persisted after the left-sided paresis, which occurred at the same time, disappeared.

One of Leschke's reported cases of diabetes insipidus, occurring as a result of a head injury, showed, in addition to the polyuria, disturbances of the sympathetic innervation in the form of vasomotor-constrictor paralysis of the left side of the body with a striking pulsation of the vessels of the head on the right side with considerable perspiration (hemihidrosis) of the same side.

In some of these instances there appears to be a decided tendency to accept the existence of a lesion in the region of the corpus subthalamicum.

Of no less importance are the rich experiences gathered in the studies of the diseases of the basal ganglia with reference to affections of the vegetative nervous system. Wollenberg reported a very interesting patient. The individual suffered from a right-sided hemichorea, combined with a hypotonia and measurable atrophy of the limbs, anhidrosis of the head on the right side, dilatation of the pupil and palpebral fissure of the right side. The cause of these derangements is attributed by Wollenberg to an encephalitic focus in the diencephalon, in all probability in the regio subthalamicum.

In addition to the above, increase of sebaceous glandular secretion frequently takes place in disease of the basal ganglia. The greasy skin is not a rare accompaniment of Parkinsonism. The oily skin must, naturally, be attributed to an increase in the glandular secretion, which, in all probability, is due to an irritation upon the floor of the third ventricle coming from the corpus striatum.

### CONNECTION BETWEEN THE DIENCEPHALON AND THE WATER, CARBOHYDRATE, AND ALBUMIN METABOLISM

A lesion of the fourth ventricle often carries with it glycosuria and polyuria. Claude-Bernard's experiments have almost conclusively proved that the water and carbohydrate metabolism are greatly

influenced by nervous impulses. These impulses reach the nervus splachnicus by way of the centers in the medulla oblongata and are further carried to the end organs. Eckardt showed in 1876 that stimulating the corpus mammillare would produce a polyuria. B. Aschner substantiated the findings. These experiments point to a possible cerebral center located in the interbrain which governs the water and the carbohydrate metabolism. Aschner succeeded in producing a polyuria and a glycosuria as high as 4 per cent through stimulating the hypothalamus. Leschke, too, succeeded in producing a polyuria, sometimes with and at other times without sugar, by injuring the tuber cinereum very close to the infundibulum.

In the light of these facts it is very difficult not to show an inclination to accept a high cerebral center, located in the gray substance of the floor of the third ventricle, in all probability the tuber cinereum, governing the water and carbohydrate metabolism. This center most likely has the duty of supervising the constancy of the bloodsugar and the osmotic pressure of the blood.

Albumin metabolism is also quite likely regulated from a position in the diencephalon. Through this regulatory factor the albumin catabolism amounts to approximately 10 to 15 per cent of the total energy. Leschke and Schneider found in their tests that the interbrain exerts an inhibitory influence on the albumin catabolism.

Their findings were substantiated by the trials of Freund and Grafe. These authors, by eliminating the diencephalon by a cross section of the cervical medulla spinalis, could get as high as 20 to 30 per cent of the total energy burnt up. This is twice as much as normal.

These tests lead one to lean very strongly to the opinion that there is a central station located in the regio subthalamicum from which inhibition regulating the catabolism of albumins emanates.

The tracts coming from this center take their course in connection with those fibers which influence the chemical heat production. According to Freund and Grafe the increase of albumin catabolism does not take place when a cross section of the medulla spinalis is made in the second dorsal instead of the cervical segment. One must conclude that, in all probability, the tracts leave the medulla spinalis somewhere in the eighth cervical or perhaps first dorsal segment. These tracts pass into the sympathetic ganglia and splanchnicus to the liver. The newer investigations have shown that the liver is not only a depot for glycogen but albumin as well. (Toennissen goes into this matter in considerable detail in his treatise "Bedeutung des vegetativen Nervensystems fuer die Wärmeregulation und den Stoffwechsel.")

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Since our information respecting the influence of the tuber cinereum over the water metabolism has become reasonably definite, our understanding of the etiology of diabetes insipidus has taken a long stride forward.

This disease is very often found as an accompanying symptom of affections of the hypophyseal gland. It was long thought that diabetes insipidus was a result of the disturbance of function of the pituitary gland. Cushing actually found, in his animal experimentation, that, not infrequently, polyuria occurred after extirpating the hypophysis.

Schaefer, Herring, and others were of the opinion that a hyperfunction of the hypophyseal gland was the cause of diabetes insipidus. Injections of hypophyseal extract followed by an increase and then afterwards a decrease of the water outflow, with influences on the concentration of the urine, induced many investigators, such as van der Velden, C. Roemer, Simmonds, and others, to believe that a lowered or failing function of the pituitary, particularly the posterior lobe, led to diabetes insipidus. Hann, Feder, Jackows, and others advanced the opinion that they considered the relation of the hypophyseal gland to the urine of a twofold character—the anterior lobe influenced an increase, the posterior lobe a decrease in urine.

These theories do not explain the occurrence of diabetes insipidus in cases with intact hypophyseal gland. Recently E. Meyer and R. Meyer-Bisch have called attention to the fact that the majority of the cases of disturbances of the gland do not have diabetes insipidus at all, and those with diabetes insipidus do not always show evidence of pituitary derangement. Soon there were instances of diabetes insipidus which pathologically showed a lesion not only of the pituitary gland but also of the tuber cinereum. Investigators turned to the infundibulum as perhaps holding the crux of the situation. Then M. Meyer, D. Gerhardt, and Leschke thought that in some instances of diabetes insipidus they had diagnosed an isolated lesion of the tuber cinereum. That would be very nice indeed if it were really so. It is a most difficult matter to diagnose an isolated lesion in the tuber cinereum, especially one affecting the water metabolism only. The hypophysis, infundibulum, and the tuber are very close together and a lesion in one is soon communicated to the other organs, so that it would make it extremely difficult to say whether it is an injury in one or the other that produces the diabetes. However, it has been repeatedly demonstrated that in extirpation of the hypophyseal gland, whether it be the anterior lobe alone or the posterior lobe alone, or both at the same time, when done without simultaneously damaging the tuber cinereum, diabetes insipidus does not take place. It is quite probable that in experimental extirpations of

the gland associated injury to the tuber cinereum sometimes occurred and, as a result of the harm done to the substance at the base of the brain, the diabetes insipidus happened. In this place it is mighty difficult to attempt extirpation of a normal gland in animals without at the same time bruising some other vital parts.

### Report of Case

Recently a child, male, 3 years old, was admitted on Doctor Wheeler's eye service at Bellevue Hospital, New York City, presenting most interesting phenomena. The child was admitted November 22, 1926. The *chief complaint* was bilateral exophthalmos.

Its father, mother, and one brother are living and well. No history of tuberculosis or cancer.

The patient was a full-term baby. It had a rash and fever when it was about 2 years old. Measles?

*Present illness.*—Two years ago slight protrusion of the right eye was observed, and since that time it has become progressively more marked. About four months ago exophthalmos of the left eye set in, becoming progressively worse. The father stated that the baby was always healthy until it had a rash about 15 months ago. Up to that time the child experienced a normal development. Since the attack of measles(?) the parents added that the child had not grown nor gained any weight. In fact, it seemed to be the opinion of the parents that the little patient lost in weight, stature remaining practically the same as 15 months ago. Patient drinks and urinates almost continuously since it was stricken with its first illness.

*Present condition.*—Patient is a little boy, 3½ years old, who appears to be well nourished; appears mentally alert. The right ear sags a little below the level of the left.

*Skull.*—X-ray reports, made at different intervals, reveal an irregular destruction and decalcification of large areas in the temporal and sphenoidal bones. Several small areas in the frontal and parietal bones also show decalcification. Examination of the rest of the osseous system does not disclose any evidence of pathology. The destruction of the areas in the temporal and sphenoidal bones are most marked on the right side.

*Eyes.*—Very marked exophthalmos. The pupils are large and do not react to light. The lids do not close entirely during sleep. They lack approximately 3 mm. of closing at center. No other positive findings on external examination. Under ether anesthesia (examination by Doctor Wheeler and Doctor Kirby), tension, O. D. 18; O. S. 20. Ocular fundi showed moderately congested veins; very slight papilledema, elevation too small to measure. Focus of eye: About emmetropia or slight hypermetropia. Exophthalmometer: O. D. 24; O. S. 23, at 84.

*Ear, nose, and throat.*—Left canal full of thick yellowish material with foul odor. Right canal collapsed and closed by what appears to be a furuncle. A small mass in nasopharynx.

*Heart.*—Negative.

*Lungs.*—Negative.

*Abdomen.*—Greatly distended. No masses; no rigidity; no tenderness. The distension might be due to the large quantities of water that the child drinks. It walks around with a cup in its hand asking everybody that passes by for water.

*Urinalysis.*—Color, pale straw. Specific gravity, 1002. Sugar and albumin, negative.

*Wassermann blood serum.*—Negative.

*Spinal fluid.*—Clear, normal pressure; cell count and albumin, negative; Wassermann, negative; sugar, 100; gold curve, 0000000000.

Although no histo-pathological findings are at hand, the case is here given in detail because it presents many very interesting characteristics. The continuous drinking and urination, the low specific gravity of the urine, the large defective spots in the cranial bones disclosed in the Röntgen pictures, the distended abdomen, marked protrusio bulbi, mental alertness, and cessation of growth lead one to believe that it is a case similar to those described by Hand and Scheuler—namely, a possible disease of the glandula hypophysis together with a lesion of the hypothalamus, in all probability the tuber cinereum. We are here possibly dealing with an injury to the cerebral center controlling the water metabolism.

Another very interesting and instructive report of a case covering clinical and histo-pathological findings was made by S. Mebel, in American Medicine, New Series, Volume XXII, Nos. 7, 8, 9, 1927. It was of a male, aged 22, observed at the National Jewish Hospital, Denver, Colo. A tubercular patient who after gaining about 35 pounds at the institution was released. Six months later he returned, complaining of dryness of the throat which caused him to drink large quantities of water. Excretion was about 23 quarts of water per day. Analysis showed that the urine was pale and clear, the specific gravity was 1.001, albumin and sugar were negative, and the reaction of the urine was alkaline. After being put on a diet lacking in NaCl and proteins and given intramuscular injections of pituitrin the excretion was finally reduced to 3 quarts per day. The patient died in February, 1926.

The autopsy revealed the following anatomico-pathologic diagnosis: Chronic ulcerative pulmonary tuberculosis, bilateral; caseous pneumonia, left lung; miliary tuberculosis of liver; tuberculous granuloma of hypophysis, posterior lobe. The brain showed a moderate amount of congestion in the meningeal vessels. There was no evidence of meningitis, tumor, or hemorrhage on the outside of the brain. The sella turcica appeared to be about normal in size. The hypophysis was slightly enlarged. There was a diffuse fibrosis of the hypophysis, indicative of a former productive reaction in the pituitary body. Mebel appears greatly inclined to attribute the diabetes inspidus in this particular instance to the tuberculous lesion of the posterior lobe of the hypophyseal gland. He summarizes by stating that the pars intermedia or the pars posterior is the seat of a hormone which controls the action of the kidney.

FIG. 1.—C. C., AGE 3 YEARS. POSSIBLE DISEASE OF GLANDULA HYPOPHYSIS WITH LESION OF HYPOTHALAMUS. TUBER CINEREUM PROBABLY INVOLVED. (POE.)

It is just cases of this type that overturn conceived pet theories, and make us pause in the acceptance of any medical facts that have not stood the test of repetition and of time.

However plausible seem the pathological findings of the hypophyseal gland, especially the posterior part, indicating that there might be found the center controlling the water regulation for the body, there has accumulated a much greater preponderance of evidence that not in this gland, but rather in the hypothalamus lies the higher center. We might agree with Sajous when he says that the pituitary is the starting point of some of the sympathetic paths which lead to a diabetes insipidus when they are injured. There undoubtedly is a large interrelationship of cerebral parts controlling the function of the kidneys. The interrelationship is necessarily controlled by paths passing to and from these various organs. That some of the fibers originate in the pituitary and go from there via the tuber cinereum, bulb, cord, and splanchnic nerves to the renal plexus, is conceivable. But we are inclined to advance the thought that these fibers do not play the higher rôle.

Many undeniable evidences, experimental as well as clinical, point strongly to a group of cells within the tuber cinereum as being the cerebral center of the water metabolism and to the view that an injury there will have in its wake a diabetes insipidus.

Diabetes mellitus has also been observed. (We are not discussing the pancreas and its diseases. The paper is limited solely to the brain.) It has been noticed in acromegalics. Many authors showed a tendency to blame the dysfunction of the hypophyseal gland. Cushing was able to cause a glycosuria by a partial extirpation of the gland. Injections of hypophyseal extracts also produced a transitory glycosuria, but did not always produce a diabetes mellitus. On the other hand, there were a number of acromegalic cases in which there was no evidence of glycosuria. B. Aschner could damage the pituitary gland without finding an increase of sugar in the urine. In 1909 the same author injured the floor of the third ventricle, which he termed the hypothalamic-sugar-bruise, which was followed by a glycosuria, with as high as 4 per cent sugar, lasting a couple of days. After totally extirpating the pituitary gland, he could produce a glycosuria by following it up with a bruise of the hypothalamus. Not being satisfied, he again injured the hypothalamus, but this time not from below, but rather from above, which procedure permitted the thought that the hypophyseal gland was not damaged, and the injury was followed by a glycosuria. Leschke, Camus, Roussy substantiated B. Aschner's findings. In fractures of the base of the skull, in apoplexias, glycosuria has made its appearance. Leschke reported a patient that had suffered

a fracture of the base of the skull, a result of which was a glycosuria up as high as 7 per cent, together with vasomotor paralysis and hemihidrosis. Also in syphilitic meningitis diabetes mellitus as well as diabetes insipidus is sometimes met with.

The findings speak fairly unmistakably for a center governing carbohydrate metabolism located in the diencephalon and that a lesion there will produce a glycosuria. Dresel, Lewy, as well as Leschke, have attempted to localize this center histologically. Their proofs, so far, are open to question. While many authorities are inclined to view with favor a location in the interbrain, perhaps the tuber cinereum, as the probable cerebral center for carbohydrate metabolism, the exact spot has not yet been established.

TROPHIC INFLUENCES ON THE SKIN AND THE SUBCUTANEOUS TISSUE

When Froehlich made public his studies of the disease generally known by his name, he attributed the singular distribution of adipose tissue to the lesion of the hypophyseal gland. This was accepted for a number of years as being possibly correct. Erdheim, however, in recent times, called attention to the fact that dystrophia adiposogenitalis also occurs with a histologically intact hypophyseal gland. He further states that hypophyseal tumors only produce adipositas in the genital region when the growth either exerts pressure upon the base of the brain or breaks into its substance. As a result of this observation Erdheim concludes that it is not the dysfunction of the gland, but rather a disease of a center located somewhere in the diencephalon, which is the etiological factor of the dystrophia.

Lately many clinical and pathological proofs have been recorded to substantiate Erdheim's findings.

Goldstein, Luce, Nonne have reported tumors of the base of the brain (not pituitary), basal fractures, hydrocephalus internus etc., in which the patients clinically suffered adiposity.

B. Aschner, on the strength of experimental efforts, has shown that there must be a center in the region of the third ventricle which regulates fat distribution.

The central nervous system also materially influences fat metabolism. Bartolotti, Dziembrowsky, and L. R. Mueller have observed very marked half-sided distribution of fat.

M. Reichardt has shown that from the psychiatric side, especially during the progress of dementia paralytica, a patient may have periods in which there occurs a high degree of fat accumulation; also periods when loss of fat tissue takes place.

In recent times a number of writers have found their way into the literature reporting cases of dystrophia adiposogenitalis and other disturbances of fat distribution following encephalitis.

A number of instances of rapid increase or loss of flesh have come to the notice of physicians in cases of meningitis. In such cases while it is true that a disturbed appetite, occurring as a result of inflamation of the meninges causes some loss of weight, it can not be held entirely accountable for the rapid emaciation that sometimes takes place. A hydrocephalus internus resulting in consequence of meningitis, in all probability because of the pressure it exerts upon the trophic centers, might be held as the etiological reason for the metabolic disturbance.

Clinical, experimental, and pathological observations seem to indicate a center located in the base of the interbrain directing the anabolism and catabolism of subcutaneous fats.

However, there are other factors involved taking part in the ingestion and destruction of fat tissue which complicate and make difficult any attempt at definitely localizing its center. Glands with internal secretion also participate in regulating its distribution. Thyroid and hypophyseal glands help influence the increase and decrease of adipose tissue, while the genital glands and hypophyseal gland assist in deciding its topographical distribution. The manner in which the glandular hormone acts is unknown. Whether it is under the direct supervision of the higher centers, or whether it exercises stimulating action on those centers, has yet to be cleared up.

## CONCLUSION

There are an exceedingly large number of cell groups located on the floor of the third ventricle. The space is very small and the number of cell groups quite large. It is, therefore, extremely difficult experimentally to injure one cell group without at the same time affecting another. The same holds clinically and pathologically. It has not as yet, been possible to produce experimentally a crystal pure function of one cell group without an intermixture of other cells, nor has it been observed clinically. The corpus Luysii of the corpus subthalamicum presents a possible exception. Because of the larger extent of its cells on the floor of the third ventricle it has been possible experimentally to establish its probable function. In this nucleus the probable centers for the innervation of the smooth musculature of the eye and bladder, also for the regulation of the blood pressure (vasomotility) and secretion of perspiration, are located.

A second group of cells governing functions might be localized in the ganglion collection in the tuber cinereum. Here may be found the center governing metabolism, also regulating bodily heat, in which metabolism plays a very important rôle. In spite of clinical experimental, and pathological data at hand, we can not as yet point our finger to a particular collection of cells and say definitely that they direct a particular physiological function.

Spiegel and Zweig have attempted to show that the tuber cinereum is, phylogenetically, made up of young groups of cells gradually developed from the lower to the higher animal. The apparent simultaneous appearance of the tuber cinereum and warmth regulation led these authors to the conclusion that possibly this gray mass does harbor the center for temperature regulation. Further, Greving was able successfully to demonstrate the existence of fibers coming from the nucleus pallidus and ending in the tuber cinereum. The rise in temperature due to a lesion in the corpus striatum, Grieving thinks, is due to these fibers conducting the impulse to the tuber nuclei. Notwithstanding, it must be admitted that our present conception that within the tuber cinereum lies a group of cells which serves as the cerebral center for animal heat regulation is still hypothetical.

The same holds good with reference to the localization of albumin, carbohydrate, and fat metabolism.

Brugsch, Dresel, and Lewy think that possibly the nucleus periventricularis regulates the sugar metabolism. They base their assumption upon the fact that in a lesion in the medulla oblongata followed by diabetes mellitus a retrograde degeneration was found in this nucleus. Dresel and Lewy conceive of the possibility that the globus pallidus might be a higher center governing the nucleus periventricularis. In four cases of diabetes mellitus which they examined they found marked changes in the outer and middle members of the globus pallidus. Leschke's observation was just the contrary. In two of his cases which he examined he found a lesion in the hypothalamus between the infundibulum and corpora mamillaria. The lesion consisted of cystic degenerations. The above citations would encourage one to believe that the cerebral localization for the sugar metabolism, while pointing strongly to the tuber cinereum, is not yet fully established. While our store of information has been greatly enriched by experimental, clinical, and pathological data, further investigation is necessary to place our knowledge of the centers located in the interbrain upon a firmer baseis.

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## MEDICAL DIFFICULTIES ENCOUNTERED BY COMBAT FORCES OPERATING IN NORTHERN NICARAGUA

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The following report of the medical difficulties encountered by combat forces in northern Nicaragua is submitted in the hope that it may assist in future similar activities, and forewarn other medical officers of previous mistakes made and difficulties constantly encountered while operating in this mountainous country.

### Selection of Men

Foremost in importance in preparing for an expedition from a medical standpoint is the selection of men physically fit to stand hardships while in the field with the least possible medical attention. In addition to a general physical inspection by the medical officer of the entire command before taking the field special attention should be paid to the feet and to men suffering from malaria and venereal infection. In examining the feet attention should be paid to corns, trichophyton infection, pes planus, and abrasions. Men with a marked trichophyton infection or markedly depressed arches should be rejected, and all corns and abrasions should be treated and protected. Under no circumstances should any men who have recently been under treatment for venereal disease or malaria be sent on an expedition of this type, as they invariably have a recurrence and become not only ineffective but a burden to the command and the medical officer, whose time and attention will be occupied by such cases to the detriment of other sick and wounded cases.

### Inspection of Clothing

Next in importance to an examination of the men is an inspection of the clothing. It is essential that men going on an expedition of this type be burdened with the least amount of clothing possible to insure bodily protection. Each man should be equipped with two pairs of shoes or, preferably, one pair of shoes and one pair of boots. The shoes issued should be at least one-half size larger than those used while in the barracks, and preferably hobnailed. In recent expeditions in this district many of the regular marine-issue shoes were found to be unfit for service after two days' wear, and many men suffered from foot complaints due to worn-out and improperly fitted shoes. Boots with the trousers pulled down over them would be the most efficient footgear for both men and officers. The marine canvas leggins were found to collect mud, and do not protect the men's legs from flea and tick bites, as is supposed. All men should have a sufficient supply of woolen socks in order to be able to keep a clean, dry pair on hand. Cotton and other types of socks are not recommended, and all men should have the issue white woolen socks.

### Medical Supplies

Before starting out the medical officer should check over his medical supplies, and should prepare an emergency kit, containing quinine in capsules, bandages, ointments, and other supplies that he might need on the trail. This emergency kit, in addition to a small package of essential surgical instruments, should be constantly under the surveillance of the medical officer or an appointed Hospital Corps

man. It has been our unfortunate experience that very essential items, such as surgical instruments and medicines when packed on mules, where the train often numbers over 200 animals, are frequently lost. It is further suggested that the base medical supplies be so arranged that all of one article will not be placed on one animal, thus lessening your chance of losing your entire supply of that article. The pack animals carrying the medical supplies should immediately follow the ammunition train, and, if possible, a Hospital Corps man should be placed with the supplies. The freshest supply of antitetanic serum should be obtained just before leaving, as it was found that this deteriorated quite rapidly, as is evidenced by the fact that one mild attack of tetanus developed after 1,500 units of a serum were given 17 days after it was received from the base hospital. Since it is impracticable at times to suspend Lister bags for chlorination of water, the following method can be employed: Prepare a stock solution in advance by dissolving an ampule of hypochloride of lime in a canteen of water and using one canteen cap of this solution for each canteen of water, instructing the men at the time not to use the water for one-half hour. As the judgment of the men in the command can not be relied upon, the medical officer and his assistants must be constantly vigilant to prevent them from drinking unchlorinated and often highly contaminated water. Halozene tablets are issued in the Guardia Nacional and can be used in place of chlorine, but they should be crushed before being placed in the canteen, as a test in the field showed that often they were not dissolved in less than one hour when placed in the canteen uncrushed. Here, also, the me nshould be instructed to wait one-half hour before drinking the water.

While our experiences with prophylactic quinine has been limited we are of the opinion that it is of great value.

In addition to the above supplies an dequipment, it is our opinion that all outlying stations that are to be maintained in this district during the rainy season should be equipped to operate as independent medical units, prepared to handle cases of all natures, as transportation of seriously sick and wounded during this season will be difficult if not impossible.

HOSPITAL CORPS MEN

The authorized quota of Hospital Corps men furnished with combat and patrol forces has not been sufficient to render emergency medical treatment in the recent operations in northern Nicaragua. In many instances it has been necessary either to leave the base hospital with insufficient corps men to handle the sick and wounded there or to send large combat patrols into the fields without a corps man or medical attendant.

In the absence of sufficient corps men to handle this work, it was found that certain members of the enlisted personnel of the Marine Corps can, with instructions, be relied upon to perform many of the duties of a Hospital Corps man. This instruction should be given even if corps men are available, as these marines, in the event that the corps man be wounded, can carry on. In addition to the instruction of capable marines to take over the duties of Hospital Corps men, the entire command should, at every available opportunity, be given instruction in first aid, especially the application of tourniquets and first-aid dressings. In the recent operations, in many instances, men and officers depended entirely upon the medical officer or Hospital Corps men to render this service. It is often impossible or impracticable for a medical officer to see a wounded man immediately, and the prompt application of a tourniquet or compress, or the application of a first-aid dressing by a near-by comrade, will, in many instances, save lives or shorten convalescence.

### Transportation

One of the most important and difficult problems with which a medical officer is confronted is the transportation of seriously wounded and sick. In the mountainous districts of northern Nicaragua, over large areas, travel is accomplished over the most rudimentary of trails, often difficult for either man or animal travel, and all modern means of transporting sick must be abandoned. For the seriously wounded, improvised stretchers or litters made with shirts, blankets, hammocks, etc., suspended on poles and carried by hand must be used. All other methods were found impracticable and generally impossible. The less seriously wounded or sick may be placed in a saddle and either strapped in place or held by an attendant. The previously described methods of transporting wounded and sick by means of a litter suspended between two animals or a strapped litter on an aparejo saddle is impossible. The use of bull carts, where bull-cart roads exist, may be employed for further transportation to landing fields or hospitals (there are no bull-cart roads from about 8 miles north of Jinotega to the Honduranean border and east of San Albino). The ideal method of evacuating sick and wounded is by plane, as was noted by the recent evacuation of Quilali when 18 serious cases were evacuated to Managua in two days. This was accomplished by a light Voigt Corsair landing on the established emergency field at Quilali, the patients being secondly evacuated from Ocotal by the larger Fokkers, all reaching Managua, 170 miles away, in excellent condition. At present, the only known fields or suitable sites for landing fields in this district are at Quilali, the plains of Apali, and at Ocotal.

### Conclusion

The treatment of the sick and wounded must, of necessity, be left largely to the judgment of the attending medical officer; however, it is our opinion that no radical or extensive surgical treatment, other than emergency, should be undertaken. Only first-aid measures, such as establishing drainage, splinting, combating infection by Dakin's method, should be employed, leaving all radical operations, where possible, to be performed in the base hospital.

### Summary

1. Selection of men to eliminate the physically unfit; paying special attention to the feet and to malarial and venereal infection.

2. *Clothing.*—(*a*) Least amount possible to provide bodily protection.

(*b*) Properly fitting shoes and boots.

(*c*) Woolen socks essential.

3. *Medical supplies.*—(*a*) Preparation of emergency kit for use while on trail.

(*b*) Emergency kit and essential surgical instruments under surveillance of medical officer or assistant at all times.

(*c*) Packing animals so all of any one article will not be on one animal, thus lessening your chance of losing your entire supply of that article.

(*d*) Obtaining fresh supply of antitetanic serum.

(*e*) Mehod of chlorination of water: (1) Lister bags, (2) stock solution of chlorine in canteens, (3) halozone tablets.

(*f*) Quinine prophylaxis.

(*g*) Stocking of outlying stations in preparation for rainy season.

4. *Hospital Corps men.*—(*a*) Insufficient number available.

(*b*) Training of marine enlisted personnel to take over Hospital Corps men's duties.

(*c*) Insufficient instruction in first-aid measures seen in entire personnel.

5. *Transportation.*—(*a*) Improvised stretchers or litters carried by hand for seriously wounded.

(*b*) Less seriously wounded and sick, transportation by saddle.

(c) Bull carts where roads are available.

(*d*) Evacuation by plane ideal.

6. *Treatment.*—(*a*) Conservatism.

## HEALTH CONDITIONS IN THE GENDARMERIE D'HAITI

By M. E. HIGGINS, Commander, Medical Corps, United States Navy, Medical Director, Gendarmerie d'Haiti

The Gendarmerie d'Haiti is a military police force which was organized in 1915 in accordance with a treaty between the Governments of the United States and Haiti.

The strength of the gendarmerie is 2,500 enlisted men and 180 officers. The former are native Haitians, practically all of whom are of pure African blood. One hundred and twenty-five of the officers are commissioned or noncommissioned officers of the United States Navy and Marine Corps; the remainder are Haitians.

The gendarmerie executes the laws of the country, furnishes urban and rural police protection, and maintains the lighthouses, prisons, and a hospital for the insane. Its officers also act as advisors to the communal civil authorities. The force is distributed to 140 stations and outposts, covering every section of the Republic.

The Medical Department, the personnel of which consists of 17 officers and 68 enlisted men, has charge of all matters relating to health and sanitation. The vital statistics collected by this department during the past five years are of interest, in that they show the trend of morbidity and mortality in the gendarmerie during that period and in addition furnish some indication of the leading causes of sickness and death among the civilian population for which accurate statistics are as yet unavailable.

The following table compares the admission, noneffective, and death rates for the gendarmerie with similar rates in the United States Navy for the year 1926:

| Year | Enlisted strength | Admission rate per 1,000 | Noneffective rate per 1,000 | Deaths | Death rate per 1,000 |
|---|---|---|---|---|---|
| GENDARMERIE D'HAITI | | | | | |
| 1923 | 2,430 | 915.2 | 19.2 | 35 | 14.4 |
| 1924 | 2,517 | 812.0 | 16.2 | 20 | 7.9 |
| 1925 | 2,505 | 851.4 | 15.4 | 18 | 7.1 |
| 1926 | 2,544 | 715.0 | 15.5 | 22 | 8.6 |
| 1927 | 2,518 | 849.0 | 20.0 | 25 | 9.9 |
| UNITED STATES NAVY | | | | | |
| 1926 | | 532.97 | 30.62 | | 3.03 |

Higher admission and death rates in the gendarmerie are due to a number of factors, the most important of which are the greater incidence of tuberculosis, malaria, and the venereal diseases. The latter cause the greater number of admissions to the sick list, while

tuberculosis is responsible for the greatest number of deaths. Prior to 1926 patients suffering from tuberculosis were discharged from the service. At present they are retained on a furlough status so that deaths from the disease appear among the total number reported for the year.

Twenty-five deaths occurred in the gendarmerie during 1927. They were due to the following causes:

| | | |
|---|---|---|
| Aneurysm, abdominal | 1 | |
| Heart disease | 4 | |
| Nephritis | 1 | |
| Peritonitis | 1 | |
| Pneumonia | 4 | |
| Septicemia | 2 | |
| Tuberculosis | 11 | |
| Wounds | 1 | |
| Total | | 25 |

### Tuberculosis

During 1927 there were 21 admissions for tuberculosis, making an annual rate of 8.8 per thousand, which is more than double the median rate observed in the United States Navy for the five-year period preceding 1926. Eleven (45 per cent) of the 25 deaths recorded for the year were due to the disease—a mortality rate for the year of 4.36 per thousand. While the numbers involved are small the death rate from tuberculosis in the gendarmerie probably reflects with considerable accuracy the rate for the population at large, since the disease is prevalent among the poorer classes and is a leading cause of death in the adult population. The necropsy records at the Haitian General Hospital, Port au Prince, show that one-third of all the deaths at that institution are due to tuberculous infection.

That tuberculosis should be one of the chief causes of death in Haiti is not surprising. The cultural level of the masses is extremely low. It is estimated that 90 per cent of the people are illiterate. They live under the most primitive conditions, have little or no knowledge or personal hygiene, and until recently had no contact with scientific medicine. Treponematosis and malaria are potent agents in decreasing the vital resistance of great numbers of people. Except among the elite and the well-to-do there is much overcrowding and many suffer from dietary deficiencies. Furthermore, facilities for the segregation of active cases and the early diagnosis of the disease are only just beginning to be available.

### Pneumonia

Next to tuberculosis, pneumonia is the infectious disease which causes the greatest number of fatalities in the gendarmerie. The

admission rate for 1927 was 9.5 per thousand; the death rate 1.5 per thousand.

During the early days of the construction of the Panama Canal it was found that the negro laborers from the various West Indian islands were particularly susceptible to pneumonia and that the disease when once established was extremely fatal. An inadequate diet, especially a deficiency in protein and fat, was shown to be an important etiological factor. When this was corrected the incidence of pneumonia rapidly declined. The diet of the masses in Haiti is low in these essential elements, a fact which no doubt plays an important part in their susceptibility to infections such as tuberculosis and pneumonia. The gendarme, because of the regularity and quality of his diet, probably suffers less from dietary deficiencies than does the average Haitian.

### Venereal Diseases

As a cause of morbidity the combined venereal diseases (chanchroid, gonorrhea, and syphilis) head the list. There were 776 admissions for venereal diseases in 1927, giving an annual rate of 308 per thousand. They accounted for 27 per cent of the sick days. Among the gendarmes ignorance as to the nature of infection and superstitious beliefs concerning the origin of disease greatly enhance the difficulties usually encountered in efforts to control this class of infections.

*Treponematosis.*—Butler and Peterson (1) have used this term to describe the yaws-syphilis group of diseases, which constitutes one of the outstanding public-health problems of Haiti. A recent survey made at the Gendarmerie Hospital, Port au Prince, on apparently healthy gendarmes, indicated that 62 per cent gave positive reactions to the Kahn test. Koltes and Albrecht (2) found positive Wassermann reactions in 70 per cent of the gendarmes examined, 68 per cent of the prisoners in the national penitentiary, and 79 per cent of the boys from an industrial school. This widespread infection with treponema makes an enormous contribution to morbidity through lowered resistance and actual disease. In the rural clinics primary and secondary yaws make up a large part of the conditions requiring treatment. Nasopharyngeal ulcerations, plantar keratosis (crab yaws), tibial ulcerations, and destructive skin lesions are commonly encountered. Aneurysms are frequently seen, and, with increasing necropsy experience, it is evident that there is much aortitis. With all this obvious disease there are, however, numerous instances where the infection is latent and the only demonstrable feature is a positive Wassermann reaction. This high degree of latency may have a definite relationship to malarial infection, since the latter

disease is prevalent in Haiti, and there are few adults who have not at some time in their lives suffered from malaria.

### Malaria

The admission rate for malaria in 1927 was 145.7 per thousand. No deaths were reported. Next to the venereal diseases malaria caused the greatest number of sick days. All types of the parasite occur, but the aestivoautumnal is by far the most common.

A survey conducted by the United Fruit Co. on laborers from all parts of Haiti who were emigrating to Cuba showed that 25 per cent harbored malarial parasites. The Haitian possesses a well-marked tolerance for malaria, but the disease decreases his vitality and lessens his ability to work. When the United States Marines were on duty in the rural districts of Haiti the admission rate among them for malaria was excessively high. In 1921 it reached 924.4 per thousand; in 1924 it was 219.9 per thousand. With the concentration of all troops in the cities of Port au Prince and Cape Haitien, where better sanitary conditions obtained, the admission rate fell to 65.4 per thousand.

In the neighborhood of the principal towns great progress has been made in sanitation, but there still exist many localities where anopheline breeding, because of the expense involved, can not be controlled.

An ubiquitous human reservoir and a wide distribution of anopheline mosquitoes make the malaria problem one of the most difficult with which public health officers have to deal.

### Intestinal Parasites

Infestation with intestinal parasites is common in the gendarmerie but is of minor importance from a standpoint of morbidity. A survey of 500 gendarmes showed: Ascarids, 21 per cent; trichurids, 19 per cent; and ancylostomes, 1 per cent. These figures are lower than those reported by the Rockefeller Foundation from a survey of the civilian population. In contrast to Porto Rico, hookworm disease is not a public-health problem of any magnitude. *Endameba histolytica* is present, but typical cases of amebic dysentery are rare.

From the foregoing it is apparent that the great cosmopolitan diseases contribute as much to morbidity and mortality in the gendarmerie as do those diseases which we are accustomed to regard as essentially tropical in their distribution.

The acute respiratory diseases and communicable infections, such as mumps, measles, and scarlet fever, which are responsible for such

a large percentage of the total number of sick days in most military organizations are of trivial import in the gendarmerie. In 1923 there was a high admission rate for bacillary dysentery, but since that time there has been a progressive decrease in admissions; only 15 cases were reported in 1927. Typhoid fever is endemic and all troops receive prophylaxis. During 1927 there were three admissions for the disease but no deaths.

With the systematic treatment of all men showing positive Wassermann reactions and educational work in connection with the venereal diseases, improvement in the admission rate for this class of infections is to be expected. Quinine is available at all stations and this opportunity for early and sustained treatment, together with the extension of sanitation throughout Haiti, will ultimately lessen the incidence of malaria. Economic conditions are steadily improving and the consequent rise in the standards of living will eliminate many of the conditions which are at present responsible for the prevalence of tuberculosis.

The past decade has been one of tremendous progress for the Republic of Haiti. One of the most conspicuous features of this forward movement has been the increase of facilities for the prevention and treatment of disease. The National Public Health Service has established 10 hospitals and is operating over 100 dispensaries and clinics, covering the entire Republic. Treponemicidal drugs are being administered at the rate of one-half million doses per year and thousands of cases of malaria are receiving treatment by quinine.

The National Agricultural Service, through numerous rural schools, is decreasing illiteracy and increasing the productive capacity of the peasant by the introduction of improved farming methods.

The gendarmerie has made a valuable contribution to these constructive efforts. During the 12 years of its existence men from all parts of Haiti have come in contact with modern medical and sanitary practice. They have been made receptive to new ideas regarding disease and have lost their fear of hospitals and surgical operations. Familiar with the benefits of scientific medicine, many have returned to their homes to form a nucleus of a force which is slowly breaking down the prestige of the voodoo doctor, whose necromancies and incantations have been the only weapons of thousands of peasants in their fight against disease.

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## BUSINESS ADMINISTRATION AT NAVAL HOSPITALS

By B. E. IRWIN, Chief Pharmacist, United States Navy

In civil life there exists an ever-increasing demand for good managers and efficient executives. Many men with exceptional ability along these lines are employed by corporations at salaries of $100,000, and more, per year. To draw such a salary a man must, of course, be associated with a big business where efficiency in administration means the savings of hundreds of thousands, or even millions, of dollars; and the pay in such cases is more in the nature of a reward for efficient administration resulting in marked economy than it is salary.

Naval hospitals can not be compared with such enormous concerns, but, nevertheless, even a comparatively small activity presents an opportunity for economical and efficient administration, with results proportionate and as laudable.

Taken as a whole, the Medical Department of the Navy is no small organization. It includes 19 naval hospitals, 2 hospital ships, 3 naval medical supply depots, the Naval Medical School, nearly 100 dispensaries located at navy yards, naval stations, submarine bases, air stations, etc., sick bays on some 200 ships, and medical examining rooms at Navy and Marine Corps recruiting stations. Some of the dispensaries on shore—e. g., those at Quantico, Va., at the training stations, the Marine Corps base, San Diego, Calif., the submarine bases at New London, Conn., and Coco Solo, Canal Zone, and at the naval station, Guantanamo Bay, Cuba—are in fact small hospitals.

The cost of maintaining and operating the Medical Department of the Navy during the fiscal year 1926 was approximately $5,500,000. During the same period the total patient days at all medical department activities were 1,739,060. The patient-days at naval hospitals alone were 1,385,359.

These figures will support the statement that the obligation to effect economical and efficient administration of so extensive an organization places no light responsibility on the officers of the Medical Department of the Navy, a responsibility that has been generally realized and most commendably met.

Many medical officers have demonstrated unusual ability as organizers and executives and have taken great interest and pride in the efficient management of the activities under their control, displaying faculties all the more creditable in view of the fact that medical schools do not teach economics or business management and a graduate of medicine is not expected to be a financier. The service training of medical officers does, of course, include administration and organization, more along military lines which emphasizes leadership, however, than in financial affairs. But when, with increased rank, duty as

executive officer at naval hospitals is assumed, the medical officer is brought into actual contact with business transactions, and it is under these circumstances that many medical officers have shown qualities which permitted development into most efficient executives and business managers.

With the budget system in effect, and accounting records kept to show financial results, either favorable or unfavorable, depending on the efficiency of the professionally trained physician and practically developed executive, we may expect a greater interest in efficient management of hospitals, as well as of the smaller medical department activities, and a general improvement in administration.

How much more desirable, however, it would be to have a business manager at each hospital—an expert especially trained in economics and financial administration, who could relieve the present executive officer of the business details and enable him to confine his attention to the professional activities of the hospital. A logical division along such lines could be made of the executive duties, with the present executive officer directly responsible for the care and treatment of the patients in the hospital and for control of the staff personnel—i. e., doctors, nurses, and hospital corps men—and the business manager directly responsible to the executive officer for the property and all financial transactions. His duties would include supervision of all property and accounting procedures, the commissary department, and the duties now assigned to the "first lieutenant."

A revision of the present internal organization at naval hospitals along these lines is now being considered by the bureau and may be included in the next edition of the Manual of the Medical Department. The changes being contemplated will not in any way affect the prerogatives of the executive officer; rather, the object is to relieve him of the details of the business management of the hospital by placing them under the supervision of a business manager directly responsible to him.

The type of organization in effect at naval hospitals is the military or line organization, the oldest and most natural form. It is based on the essential need of discipline where the efforts of a large number of persons must be directed toward a common objective. The lines of authority and instruction are all vertical from superior to subordinate, extending from the commanding officer to the hospital apprentices and the civilian laborers. The mental work of administration is reserved for those in higher authority; simple duties are delegated to those under them. In order to render group effort effective and efficient, the duties and responsibilities of each member of the group are clearly defined. The advantages of this type of organization are simplicity, clear definition of duties and responsibilities, and ease of securing discipline.

It is particularly desirable in an organization of this type that lines of authority be clear-cut and definite, each subordinate being directly responsible to and receiving his orders from one immediate superior. The lines of authority should be so well defined that every member of the organization knows what he is responsible for and to whom. For example, in the new organization plan mentioned above, the property officer will be directly responsible to his immediate superior, the accounting officer; the accounting, personnel, and commissary officers will take their orders from and be directly responsible to their immediate superior officers, the business manager; and the business manager will receive his orders from and be directly responsible to the executive officer, who, of course, is responsible to the commanding officer.

In practice this theory of a perfect organization is not always followed; short cuts, both in giving orders and in submitting reports, etc., are too often found convenient. The personnel officer may be called in by the commanding officer and will transact business with him direct, with the result that the offices of the business manager and the executive officer will be ignored and the lines of authority broken. But such procedure in a civil corporation would not be tolerated and, in the interests of administrative efficiency and coöperative effort, should be avoided as much as possible.

The commanding officer of a naval hospital may be compared to the president of a business corporation in civil life and the executive officer to the vice president and general manager of such an organization.

Under the present system the function of the executive officer, from an economic viewpoint is, of course, to supervise and manage the hospital as a business organization. He should have a comprehensive view of the business activities. He must see that the various departments are properly correlated; that they are so organized as to operate smoothly and efficiently.

There must necessarily be a close correlation of organization and accounting. The responsibility for the conduct of each department should be definitely assigned and the results obtained measured in figures. A proper control and management of business affairs can not be exercised without the information supplied by the accounting department. Accounts record the business history of a concern, and the purpose of an accounting system is chiefly to collect the business details and use them to build up summary reports which give in concise form the entire record for the fiscal period. These summary reports furnish a review of the operations of the business as a whole and are invaluable in the formulation of administrative judgments and policies. Accurate and comprehensive records are quite as im-

portant to a business as are the charts and compass to a ship at sea. In any large and successful business the accounting department is looked upon as one of the most important factors of success.

It is necessary to emphasize the importance of internal financial control, and the accounting system exercises this control at all times in all departments and activities of the hospital. Each department is charged with the cost of its operation, and, as the various departments are subject in some degree to separate control, responsibility for increases and decreases may be readily traced and brought to the notice of the individuals primarily responsible.

One of the advantages of a cost system is that it promotes effective control and coordination of departments. By studying the elements of cost, ways can often be found to effect economies without impairing efficiency. Extravagant administration is inefficient regardless of the services rendered, and the quality of management should be measured by its cost in time and money as well as by the results accomplished. The manager of a business is required to make plans and form judgments, which should be based on accurate and comprehensive information. With an adequate and efficient accounting department at his command he has a reliable source of such information. By studying, analyzing, and properly interpreting the accounting records and reports he has something definite on which to base his judgments. The history of past fiscal periods is an invaluable aid in the formation of future policies.

The tendency of one not trained in business administration is to be narrow, arbitrary, and unyielding in his views of the function of accounting and of methods of keeping the records of business. It is only by the practical application of accounting principles and by viewing the results obtained by the application of these principles that he can see the advantages of a detailed accounting system.

The introduction of the Bureau of Medicine and Surgery accounting system did not meet with unanimous approval at first, but after a fair trial even the most conservative member of the Medical Department have been convinced of its merits. The results obtained speak for themselves more eloquently than any mere words. With the figures now at its command the bureau can at a moment's notice not only show the exact status of any M. and S. appropriation and the Naval Hospital Fund, but can also produce a complete and analytical statement of all expenditures made from these funds during any fiscal year since the accounting system has been in effect.

The advantages of having such statements at hand can be fully appreciated only by those who have been called before the Bureau of the Budget and congressional committees to support estimates of funds required in future years to maintain and operate the Medical Department of the Navy. Although the value of the accounting

records, the allotments, and reports of expenditures and the operating-cost statements, with the analysis by the various subheads, has been demonstrated at the individual Medical Department activities, especially in connection with the preparation of the annual estimates on which the bureau bases the budgets, the bureau makes no claim that the Medicine and Surgery accounting system is perfect. Probably its principal virtue is its simplicity—a simplicity that was definitely striven for in order that the system might prove practicable when applied by persons inexperienced in accounting work. But this very feature renders the system open to criticism by the trained accountant. Theoretically the system could be improved upon; practically it works and produces the desired results.

One of the big features of any cost system is depreciation, and this is one of the features of the M. and S. system that is not handled according to the best accounting principles. Theoretically, depreciation of buildings and equipment should be written off on a percentage basis so that it will be distributed to the operating cost equally over each accounting period; that is, for each quarter so far as the M. and S. system is concerned.

Practically such a procedure involves accounting difficulties that would stump the untrained man, and the method adopted of charging operating cost with the book value of equipment as it is surveyed is considered fairly equitable. If surveys are held quarterly and old and worn-out equipment is not allowed to accumulate, depreciation costs may be distributed over each accounting period so that the operating cost during any one quarter will not be unduly influenced.

Depreciation on buildings has not been taken into consideration at all, principally for the reason that the normal trend of real-estate values is to increase and this tendency, so far as naval hospitals are concerned, will undoubtedly offset any decrease in the value of buildings due to depreciation. It is a well-established fact that the value of land, generally speaking, is constantly increasing.

In the M. and S. accounting system no provision is made for distributing overhead expenses to the various hospital departments. These expenses include such items as coal, water, and electricity, which are charged to the "Heat, Light, and Power Department." The distribution of overhead is one of the most technical phases of cost accounting and in manufacturing concerns is one of the most essential and important phases. The general principles of hospital accounting are the same as those of commercial accounting, but owing to the peculiar nature of such institutions, their organization, their functions, and their methods of finance, certain fundamental differences in accounting procedures exist. Fundamentally the private business is conducted for the purpose of making a profit.

The naval hospital exists to render services to patients, the profit element not being involved. The accounting records of a manufacturing enterprise, for instance, are necessarily much more complicated than those of an institution which limits its activities to the furnishing of personal services.

Even the accounting system in a civilian hospital must be more complex than that of a naval hospital, because of the difference in the method of financing. A civilian hospital has income to record and charges for the service rendered. To prorate service charges it is necessary to distribute the overhead expenses. No such charges are made at naval hospitals and, while the distribution to each department of its share of the indirect expenses would be correct in theory, as a practical matter there is no good reason for adding this technical phase to the M. and S. accounting system. Too much theory is not only discouraging even to the technically trained, but it defeats its own purpose by failing in practice. The complexity of a system is no guarantee of its accuracy. It is to be hoped that the accounting system at naval hospitals will not grow to be a complicated and unwieldy mass of detail as the result of misdirected efforts to make it theoretically perfect.

In formulating any accounting system the principal thing to be borne in mind is the purpose of it all, and then the accounting procedures and records should be as simple as possible to accomplish that purpose. Too much detail is not only confusing but unnecessary work will lead to a half-hearted cooperation on the part of the individuals who are charged with keeping the records.

There were two principal objects to be accomplished by the installation of an accounting system in the Medical Department of the Navy. One of these was to record expenditures from M. and S. appropriations and the Naval Hospital Fund; the other was to determine the operating costs of the various Medical Department activities. The simple system now in effect has accomplished both of these objects to a degree of accuracy beyond all expectations, considering the hundreds of activities and thousands of people concerned.

In order to control the operating costs at hospitals it was necessary to divide these costs by departments. Provision was made for segregating costs in this manner in the Expense Analysis Register, and also for the preparation of a monthly Expense Analysis Statement for each department. By reference to these records the trend of operating costs may be watched and regulated. These records, in particular, show results. A careful study and correct interpretation of them will elicit the information necessary definitely to place responsibility for any extravagance, as well as to determine to whom credit should be given for any marked economies effected.

The responsibility for the administration of naval hospitals is placed directly on the commanding officer. Whether he succeeds in his efforts to carry on efficiently and economically depends to a great extent upon the executive ability of his subordinate officers who are charged with the control of operating costs and of the financial transactions.

Modern executives and business managers, directing the policy and operation of large concerns, must rely on records in order to keep informed of the conduct of the business and to exercise intelligent control. The accounting records at naval hospitals should be referred to by those who are concerned with the business details, and they should be used as a constant guide toward managerial efficiency.

So far as the economical administration of naval hospitals is concerned, merely a running start has been made. The maximum of efficiency in this respect lies far ahead. Future progress depends on the intelligent application of modern business principles; the accounting records furnish the guide, and results will be measured by the monthly " Recapitulation " submitted to the bureau.

# CLINICAL NOTES

## TULAREMIA

### REPORT OF FOUR CASES, ONE FATAL, WITH AUTOPSY REPORT

By CHARLES W. O. BUNKER, Commander, Medical Corps, United States Navy, and EBEN E. SMITH, Lieutenant Commander, Medical Corps, United States Navy

Much credit is due McCoy and Francis for establishing tularemia as a clinical entity. Few are ever privileged to make such an important and permanent contribution to the science of medicine. Reports prove that this disease is widely distributed and its occurrence is not rare, yet its recognition is comparatively quite recent. Lack of familiarity with this disease apparently accounts for failure to make the correct diagnosis more frequently.

Report of four cases of tularemia is submitted. The first illustrates a typical, relatively mild case that could easily have passed unrecognized had not interest been focused upon this disease by the third case. A typical history was found in this case when it was sought. The second illustrates the debility and refractory chronicity of lesions that may follow the acute attack. The third, a fatal case, is of particular interest. Tularemia was suspected early in its course and, largely through the personal interest of Doctor Francis, it furnished an unusual opportunity to investigate this interesting disease during life and post-mortem. The fourth is reported because of its close association with this fatal case.

#### CASE No. 1

C. W. S. Admitted to United States Naval Hospital, Washington, D. C., November 25, 1927.

*Complaint.*—Insomnia, fever, and loss of appetite.

*Past and family history.*—Irrelevant.

*Present illness.*—On November 15 patient was hunting near Washington, D. C. He shot and cleaned several rabbits. Two or three days later he was suddenly taken ill with chills, aches all over, and sharp pain in the back. Temperature, 102° F. A short time later he noticed a sore on the little finger of his left hand. Symptoms continued, including night sweats. Aches were sufficient to make him sleepless. Appetite was poor, and he lost about 10 pounds in weight before admission.

On admission ulcer was still present and the left epitrochlear lymph node was swollen and tender. His skin was quite moist. Breath sounds were indistinct on both sides, almost inaudible over the left upper, and scattered râles

were present over both upper lobes. Heart sounds were weak. The temperature, pulse, and respiration were febrile, becoming normal on November 28.

On December 6 serum from this case was submitted to Doctor Francis, of the Hygenic Laboratory. This was positive to *B. tularense* in a dilution of 1–640.

*Other laboratory findings.*—Blood: Red-blood cells, 4,600,000; hemoglobin, 80 per cent; white-blood cells, 8,500; polynuclears, 67 per cent; lymphocytes, 31 per cent; mononuclears, 2 per cent. Urine: Slight trace of albumin. Sputum: Five negative reports for tuberculosis.

X ray, November 30: "With the exception of rather heavy scarring at the hilum the lung fields are essentially negative."

Patient was discharged December 23. His ulcer was healed but lymphadenitis persisted.

### Case No. 2

S. L. J. White male, aged 27. Admitted to United States Naval Hospital, Washington, D. C., December 30, 1927.

*Complaint.*—Painful and swollen glands and lassitude.

*Past and family history.*—Irrelevant.

*Present illness.*—On November 24 patient was hunting near Washington, D. C. He skinned and cleaned 35 rabbits. November 30 three ulcers appeared on the fingers of his left hand and he had painful swelling at the elbow and axilla of his left arm. The next day he had chills and fever and had to go to bed. December 3 he had a temperature of 106° F., and noted a sore on his right hand and painful swelling at the elbow and axilla. He remained in bed, and his fever and general symptoms gradually subsided and ulcers healed.

Admission to the hospital was for painful and persistent lymphadenitis. Physical examination was essentially negative except for healed lesions and swollen and tender epitrochlear and axillary lymph nodes, especially on the left side. Fluctuation was present. The four groups were incised and drained on February 3. The pus obtained from these glands was sterile on smear and culture, and was nonpathogenic on animal inoculation.

Serum from this case was submitted to Doctor Francis, who reported agglutination of *B. tularense* in a dilution of 1–1280 on January 4, 1928. There were no other significant laboratory findings. During hospitalization patient's temperature was fluctuant around normal and his pulse was fluctuant around 90. Respiration normal. He was discharged February 6, the incisions still draining.

### Case No. 3

J. G. F. Admitted to the United States Naval Hospital, Washington, D. C., November 30, 1927. Retired officer, aged 65.

*Chief complaint.*—"Grippe," with fever. Patient was mentally clear, febrile, and exhausted.

*Previous and family history.*—Mostly irrelevant. Patient had pulmonary tuberculosis about 1890 with apparent cure, and amebic dysentery about the same time. A tendency to colitis persisted. In 1925 he had pneumonia.

*Present history.*—Patient had been below par all fall, being easily fatigued but without other symptoms except slight loss of weight. He was an unusually active man for his age. On November 17, while hunting quail near Orange, Va., patient received a slight corneal abrasion and a large subjunctival hemorrhage of the left eye from trauma by a bramble. This was treated by a local specialist, and condition had practically subsided at time of admission.

On November 18, while hunting in the same locality, he punctured the thumb and ring finger of his right hand with thorns. On or about November 19 patient

and his brother, M. G. F., and nephew, J. W., skinned and dressed three rabbits. He wore gloves, but stated that they had holes. Patient was a physician and examined the livers of these rabbits for tularemia and considered them normal, but he stated that they were examined in poor light.

On November 24 patient developed a temperature of 101° F., associated with malaise and anorexia, and he felt tired and weak. On the following day he developed generalized aches, especially orbital, and hyperesthesia of the skin. He attributed the symptoms to an attack of influenza. He attended a dance in the evening.

On November 26 the right thumb was incised at point of puncture, and some pus was found. This lesion did not throb, and patient noted no pain or tenderness of the regional glands. Constitutional symptoms persisted, and he in addition had chilliness and night sweat.

On November 28 he felt somewhat better and drove his car from Washington, D. C., to Orange, Va., a distance of 92 miles, and then took his brother, M. G. F., who had been ill with "bronco-pneumonia" since November 23, to the University of Virginia Hospital, whose medical service contemplates reporting the case. The course of the disease in this patient was severe. The nephew, J. W., who had assisted in dressing the game, had also been ill since November 25 with "grippe."

*Physical findings on admission November 30.*—Tall, spare man, age 65. Acutely ill, face suffused, kept eyes closed most of the time (photophobia). Temperature, 104.2° F.; Pulse, 96; Respiration 27. Tongue moderately coated. Heart sounds faint, no murmur, pulse regular and full, arteries tortuous and moderately hard. Lungs: Respiratory sounds exaggerated, slight dullness and increased whispered voice external to right nipple to below angle right scapula. No cough, râles, or bronchial breathing. Abdomen: Negative except for gas in colon. Right hand: Incised necrotic ulcer wtih slight thin discharge, along side right thumb nail; necrotic area 4 by 8 millimeters along side nail of ring finger. No redness along lymphatics. Right epitrochlear and axillary lymph nodes hard, freely movable, and not tender.

*Clinical course.*—Patient was put to bed and fluids forced orally, by rectum, and intravenously. The lesions of the eye and fingers received local treatment. Cardiac stimulants were resorted to as the heart began to fail. There was some suggestion of mental confusion on December 2, and patient became delirious on the 3d. By the 4th patient was in a severe typhoidal state with low-muttering delirium, carphologia, marked subsultus tendinum, and, on the last day, risus sardonicus. The temperature attained 104° F. on the 3d, and became remittent, fluctuating from 100° to 104° F. (axilla) during the following days. On the 5th the pulse rate increased to 108, became smaller, softer, and irregular, later increasing to 142. It responded somewhat to stimulants. On this date, respiration averaged 22 and a dry cough developed, and generalized coarse râles were noted. Some very tenacious, mucilaginous, prune-juice tinted sputum was produced on the 6th. A terminal broncho-pneumonia and pulmonary edema developed, and the respiratory rate increased to 44, and dullness was noted over the right lower lobe. The night of December 7 patient was comatose, Cheyne-Stokes respiration developed, and he died at midnight of circulatory and respiratory failure. A blotchy evanescent erythema was present during the last day.

*Laboratory findings.*—Blood: December 1, red-blood cells, 4,230,000; hemoglobin, 70 per cent (Dare); white-blood cells, 9,400; polynuclears, 67 per cent; lymphocytes, 33 per cent.

Blood: December 2, white-blood cells, 6,600; polynuclears, 75 per cent; lymphocytes, 23 per cent; mononuclears, 2 per cent.

Blood culture: December 3, negative (taken November 30).

Blood chemistry: December 6, nonprotein nitrogen, 90; urea nitrogen, 56; uric acid, 5.5; creatinine, 2.5; sugar, 150; chlorides, 410; calcium, 8.9; plasma $CO_2$, 52.

Widal-reaction for typhoid and paratyphoids: December 5, negative.

Smear from secretion from thumb lesion: December 1, negative for organisms.

Smear from necrotic material obtained from lesion, ring finger: December 1, showed gram-positive cocci.

Urine examination: December 5, specific gravity, 1.015; albumin, trace; sugar, negative; casts, numerous fine and coarse granular; culture for *B. typhosus*, negative.

Sputum: December 6, reported as showing large and small Gram-positive cocci. Some diplococcus forms and some short chains present.

X-ray: Conclusions reported under date of November 30:

The aortic shadow is suggestive of arteriosclerosis. The lung fields are suggestive of chronic pulmonary tuberculosis, probably arrested in both apices. The appearance of the right lower lobe is suggestive of a secondary acute infection.

Tularemia was suspected early in the course of this case and clinical and pathological material was submitted to Dr. Edward Francis, surgeon, United States Public Health Service, of the Hygiene Laboratory. The complete report, as submitted by Doctor Francis, follows:

### Ulcer of Finger

*Animal inoculation.*—December 2, 1927, necrotic tissue from an ulcer on the finger was injected subcutaneously into two guinea pigs, and on December 6, 1927, pig No. 1 was dead and pig No. 2 was killed while in a dying condition. Both pigs showed the typical gross lesions of tularemia—caseous lymph nodes, spotted spleen, and spotted liver. Spleen tissue of each pig was rubbed on the shaven abraded skin of the abdomen of two fresh pigs; these died between December 9 and 11, manifesting the typical gross lesions of tularemia.

Two mice which were inoculated subcutaneously December 6, 1927, from the spleen of pig No. 1 died December 9, showing the typical enlarged spotted spleen.

*Cultures.*—Blood glucose cystine agar and plain agar were inoculated from the heart blood of the above pigs and mice, and after from two to three days of incubation pure cultures of *Bacterium tularense* grew on the cystine medium, while the plain agar remained sterile. The organism was coccoidal and bacillary, nonmotile and Gram-negative, and was agglutinated out to the full anti-*tularense* titre (1:1280) of a known tularemia serum.

*Microscopic changes.*—Sections of the guinea-pig spleens, livers, and inguinal lymph nodes showed the typical focal necroses of tularemia. Sections of the mouse liver showed the characteristic invasion of the hepatic cells by the organisms. The mouse spleen showed confluent necroses.

### Sputum

*Animal inoculations.*—December 6, 1927, sputum collected from the patient was injected subcutaneously into two guinea pigs, both of which died December 10, manifesting the typical gross lesions of tularemia. Spleen tissue of

these animals was rubbed on the shaven, abraded skin of other pigs which died December 14 with the typical gross lesions.

*Cultures.*—Culture media inoculated from the above pigs have yielded pure cultures of *Bacterium tularense.*

### Autopsy Material

*Animal inoculations.*—The patient's heart blood, spleen, liver, and lung tissue were injected December 8, each into a set of four guinea pigs, all of which died in from three to five days, manifesting the typical gross lesions of tularemia. Spleen tissue from the above pigs was rubbed on the shaven abraded skin of fresh pigs, all of which died acutely with typical lesions.

*Cultures.*—Pure cultures of *Bacterium tularense* have been obtained from the four series of pigs inoculated with heart blood, liver, lung, and spleen.

### Agglutination Tests

Following is the tabulated report of agglutination tests with the blood serum of J. G. F. Serums were unheated and without preservative. Mixtures were incubated two and one-half hours at 37° C., then placed in the cold room and read next morning.

| Blood collected | Antigens | Serum dilutions, 1 in— | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2 | 5 | 10 | 20 | 40 | 80 |
| Dec. 1, 1927 | Tularense | 0 | 0 | 0 | 0 | 0 | 0 |
| Do | Abortus | 0 | 0 | 0 | 0 | 0 | 0 |
| Dec. 5, 1927 | Tularense | 0 | 0 | 0 | 0 | 0 | 0 |
| Do | Abortus | 0 | 0 | 0 | 0 | 0 | 0 |
| Dec. 8, 1927 | Tularense | 4 | 4 | 4 | 0 | 0 | 0 |
| Do | Abortus | 0 | 0 | 0 | 0 | 0 | 0 |

I interpret the tardy development and low titre of the agglutinins as being in accord with a failure on the part of the patient to form antibodies of any kind as indicated by his downward clinical course.

The serum reported on under date of December 8 was obtained at autopsy.

### AUTOPSY REPORT ON CASE J. G. F.

This fatal case was autopsied by one of us (E. E. S.) 10 hours after death and complete report follows:

*General.*—Body is that of a white male. Height, 70.5 inches; weight, approximately 145 pounds; age, approximately 65 years; hair, brown, turning gray, rather sparse; complexion, brunette. Deformity both wrists. Emaciation is fairly marked. There is considerable post-mortem lividity which is diffuse over back, and patchy over sides of thighs, sides of chest, and surrounding the neck. Rigor-mortis is well developed and body is cold. Eyes, brown, pupils moderately contracted, equal. No discharges. Skull, negative. Teeth, in fair state of preservation; prosthetic work consists of lower bilateral molar plate. Tongue, heavily coated. Hand: On the right hand there are two lesions. One is on the right thumb just medial to the nail. Lesion is approximately 1.5 centimeters in length, is covered with a heavy scab and depressed centrally with little surrounding inflammatory reaction. On the ring finger of this hand, situ-

ated lateral to the root of the nail, there is a similar lesion somewhat smaller. There is definite cyanosis of nails. The right epithrochlear lymph node is quite large. There is no conspicuous enlargement of the axillary nodes, although they are definitely palpable.

*Chest.*—On opening chest, deep straw-colored fluid exudes from the right side. On aspiration, this measures 28 ounces. Heart is not enlarged; feels rather flabby. There is an increase of pericardial fluid which is deeply tinted. Pericardium is apparently normal, except for some congestion. The right side is dilated, particularly the auricle. The heart is distinctly fatty. Thymus is not identified. There is no particular enlargement of the mediastinal lymph nodes. Pleural adhesions are present at both apices, particularly the left.

*Lung, right.*—Weight, 1,280 grams. The lower lobe shows consolidation. This is especially noted in two areas, cut section of which shows patches of broncho-pneumonia. The surface of the lung shows about six or eight white areas approximately three-fourths inch in diameter which do not extend into the substance of the lung. On section consolidated areas are firm, grayish in color, and contain no air, sinking in water. The other parts of the lung contain air and are apparently normal except for congestion.

*Lung, left.*—Weight, 825 grams; is air-containing, shows no solidification. and no spots on the pleural surface. On section the lung is distinctly reddened and moist. Fibrous adhesions are fairly dense over the apex.

*Heart.*—Weight, 435 grams, including 15 centimeters of aorta. Right auricle is dilated and contains a little clotted blood. Tricuspid valve measures 13.5 centimeters. The right ventricle is dilated somewhat. Right ventricular wall measures 3 centimeters. Pulmonary ring measures 8 centimeters. Mitral valve measures 11 centimeters. Left ventricle is contracted. Ventricular wall averages 1.5 centimeters. Aortic ring is 8.5 centimeters. Ascending arch 8.5 centimeters in circumference. Heart muscle is quite flabby, rather pale red in color. Foramen ovale is patent but closed with apposed folds that probably prevented much leakage. There is some sclerosis of all valves, with no suggestion of stenosis. At the base of the aortic valve there is a little calcification and there is a definite but not marked atherosclerosis of the aorta. The coronaries are patent; the right having an accessory duplication.

*Abdomen.*—On opening abdomen, intestines are found ballooned with gas, particularly the colon and cecum. Fluid escapes which is distinctly turbid. Peritoneum is smooth and glistening throughout. Vessels are somewhat congested. The pelvis is half filled with turbid fluid. The liver extends one fingerbreadth below costal margin. There are numerous adhesions in the region of the gall bladder connecting with the duodenum. The abdominal tissues are definitely edematous.

*Gastrointestinal tract.*—No conspicuous changes found. Stomach and intestines contain a little partially digested food. The stomach is moderately dilated with gas and the same condition exists in the intestines, the cecum being markedly dilated. The mucosa of the entire tract is congested, and there are some petechial hemorrhages in the stomach. The appendix is apparently normal. There are a few enlarged, soft lymph nodes in the mesentery.

*Liver.*—Weight, 1,410 grams. The external surface of the liver shows no nodules, neither are they present on cut section. Gall bladder contains about 5 cubic centimeters of turbid, thick, dark golden bile. Gall bladder negative except for adhesions already noted. Ducts are patent.

*Pancreas.*—Soft, distinctly pale. Vessels are congested.

*Adrenals.*—Both appear normal.

*Spleen.*—Weight, 145 grams, red, very friable. The external surface shows a few very small, gray spots about the size of a pinhead. The cut surface does not show these spots.

*Genito-urinary tract.*—Kidneys are enucleated without difficulty. They are soft, flabby, and dark red in color. Capsules strip readily, leaving a dark-red granular surface. On careful inspection, many fine gray punctate areas are noted on surface of cortex. The gray areas can not be definitely identified beneath the cortex of either kidney. Kidney, right: Weight, 170 grams. On section cortex is poorly demarcated, averaging 8 millimeters. Pelvis not dilated, congested. Kidney, left: Weight, 185 grams; resembles right. Ureters normal. Bladder is contracted, containing about 5 cubic centimeters turbid urine. Prostate palpable, not hypertrophied or indurated.

HISTOPATHOLOGICAL

*Hand.*—Section is taken from ulcer on thumb and includes epithelial border and base of ulcer. The epithelium is covered with a thick cornified layer. Border is rounded and does not penetrate the deeper tissue. Base of ulcer is covered with necrotic débris. Beneath the epithelium and at the base of the ulcer there is extensive inflammatory infiltration and necrosis. This is superficial and the deeper tissues are relatively uninvolved. Lymphocytes, endothelial cells, plasma cells, and polynuclears are all present in abundance. There is much nuclear débris. The lesion is a coagulative necrosis which is diffuse rather than focal. Vascular congestion is conspicuous. Some of the vessels in the base of the ulcer are thrombosed.

*Right epithrochlear gland.*—An extensive necrotic process, similar to that noted in the base of ulcer, involves the entire gland. It shows some tendency to focal necrosis, and diffuse infiltration and edema with congestion are conspicuous. No giant cells found.

*Lung.*—Section from consolidated area is identified with much difficulty as practically no structure remains. Section consists of a diffuse infiltration with polynuclears predominating, associated with lymphocytes, endothelial cells, and much débris. Section from other portion of lung shows extensive capillary congestion with considerable free blood and coagulated albumin in the alveoli. Section from trachea shows nothing but vascular congestion and edema.

*Heart.*—Vessels are congested, fibers are separated, and protoplasm stains rather pale and granular. Aorta: Fairly extensive atheromatous degeneration is present with some calcification.

*Liver.*—Lobulation is indistinct. There is a diffuse atrophy, granular degeneration and vacuolation of the hepatic cells, which is extensive in degree. There is little congestion and practically no infiltration. Section from wall of gall bladder shows a thick fibrotic wall, marked vascular congestion, and moderate amount of diffuse inflammatory infiltration, the mucous membrane being practically uninvolved.

*Pancreas.*—No conspicuous change noted.

*Spleen.*—This tissue shows marked change. There is a marked increase of blood, particularly in focal areas where it is undergoing disintegration and is associated with cellular infiltration and necrosis. Infiltration resembles that noted in lymph glands but the process is less advanced. Follicles are atrophic.

*Kidney.*—Section fails to show any inflammatory infiltration. Vessels are congested, particularly the capillary tufts. The tubular epithelium shows an advanced stage of granular degeneration. There are a few focal areas showing extravasated blood.

*Adrenal.*—Section is free from inflammatory infiltration. Vessels are congested. There is extensive granular and vacuolar degeneration of both the cortex and medullary portion, more advanced in the latter.

### Bacteriological

Stains to demonstrate bacteria in the lesions failed definitely to demonstrate any organisms.

### Summary

These lesions are typical of tularemia, and are characterized in this case by diffuse rather than focal coagulative necrosis, which is consistent with a rather rapid fatal course. These lesions alone are not, however, sufficiently characteristic to be diagnostic except as being associated with a typical history, positive serological and bacteriological findings, and typical lesions on animal inoculation. Positive diagnosis of tularemia is made on these consistent composite findings.

### Pathological Diagnosis

*Tularemia.*—Primary lesion: Ulcers thumb and ring finger right hand. Secondary lesions: Coagulative necrosis of (1) regional lymph node, (2) lung, (3) spleen, (4) lymph nodes. Parenchymatous degeneration, acute, of (1) heart, (2) liver, (3) kidney (nephrosis), (4) adrenal. Passive congestion of viscera. Pleural effusion. Ascites. Patent foramen ovale. Pleural adhesions.

### Case No. 4

The illness of J. W., nephew of this fatal case, was investigated and the following brief notes were made:

J. W., a man, having been a member of the hunting party which skinned and dressed three rabbits November 19, 1927, became slightly ill November 25 with malaise, muscular pains of the body and limbs, and perhaps slight fever. On first examination by a physician December 5 he stated that he had no ulcer on his hands nor in his eyes and no glandular pain or swelling; evening temperature December 5 was 99.4° F., and there was a very slight bilateral conjunctivitis. Blood serum, collected December 12 and 21, agglutinated *Bacterium tularense* in dilution of (1:1280) on both occasions. The course of the disease in this case was mild.

### COMMENT

Several pertinent conclusions may be drawn from a consideration of tularemia in general and from these cases in particular.

1. Tularemia is a definite clinical entity, and infection with *B. tularense* is the etiological factor. This organism was first isolated by McCoy and Chapin[1] in 1912 from ground squirrels in Tulare County, Calif. Francis[2] in 1919, obtained conclusive proof that this organism may be pathogenic for man, and in 1921[3] proposed the term "tularemia" for the disease. Many subsequent reports have substantiated these findings and demonstrated the wide distribution and not uncommon occurrence of this infection. While

[1] Public Health Bulletin No. 53, 1912, 21.
[2] Public Health Report, 34, 1919, 2061–2.
[3] Public Health Report, 36, 1921, 1731–38.

recognition of this disease has been only comparatively recent, its occurrence is known to have dated back for years. Marketmen have been familiar with "rabbit fever" for a long time, and recent serological investigation has proved many of these cases to be tularemia.

2. The infection occurs primarily in wild rodents. Infection of man is incidental. Among wild rodents it is transmitted by blood-sucking insects, sometimes assuming epidemic form. It is highly contagious from animals to man by self-inoculation or through the bites of blood-sucking insects. From man to man, however, contagion is negligible. No contact with our fatal case and his discharges acquired the disease and no particular precautions were taken to avoid contagion.

3. Francis and Callender[4] reviewed 323 cases of tularemia and concluded that there are four clinical types of this disease.

(*a*) Ulceroglandular, the primary lesion being a papule which ulcerates, accompanied by enlargement of the regional lymph nodes. This is the usual clinical manifestation. The initial lesion is an indolent necrotic ulcer usually associated with some trauma including tick bite or fly bite. The hand is a common site. Experience has demonstrated that these lesions are refractory to usual treatment and surgical interference is contraindicated. The regional lymphadenitis is associated with this local lesion. This condition also runs a protracted course and may go on to suppuration requiring surgical intervention as did our second case. Our first three cases fall in this group. Although ulceroglandular manifestations were present in our third case during the second week, they represented a relatively minor feature of the clinical picture. This patient's prostration and ultimate death can not be attributed to the local ulcers and adenitis except that the ulcers represented the portal of entry for a generalized systemic infection.

(*b*) Oculoglandular, the primary lesion being a conjunctivitis accompanied by enlargement of the regional lymph nodes. Infection probably occurs by rubbing infectious material into the eye. There is some suggestion that our fatal case had a primary ocular lesion in addition to his digital lesions. Against this hypothesis is the fact that the ocular lesion was without enlargement of the regional lymph nodes and responded to routine treatment while the other lesions did not.

(*c*) Glandular, without a primary lesion but with enlargement of the lymph nodes.

(*d*) Typhoidal, without primary lesion and without glandular enlargement. This type is uncommon except in laboratory workers. Our fourth case is of this type.

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[4] Arch. Pathology and Laboratory Medicine, 3, 557–607, 1927.

4. Positive diagnosis is based upon finding serum agglutinins for *B. tularense*. These appear in the second week and persist for years. A presumptive diagnosis can be made on a history of dressing rabbits or being bitten by a fly or tick, the development of an indolent refractory necrotic ulcer, a persistent regional lymphadenitis, and manifestation of acute infection. Final positive diagnosis can be obtained by isolation of cultures from animals inoculated with infectious material from patients. Guinea pigs are highly susceptible and show characteristic lesions. Incidentally, these infected animals are highly contagious for nonimmune laboratory personnel who autopsy them. It is not known how long viable organisms persist in the granulomatous lesions. Case number two would suggest that material from the patient is not infectious two months after the initial lesion. Francis reports that infected rabbits are noninfectious after 30 days in cold storage. This is not a simple sterilization by refrigeration, as this investigator keeps his stock strains in tissue preserved in glycerin at refrigerator temperature. The histopathological findings in human tissue vary from an acute diffuse inflammatory exudate with extensive coagulative necrosis terminating fatally to an essentially subacute or chronic focal proliferative process resulting in minor disability. Thus the microscopic picture may be quite variable, and while it may be suggestive of tularemia it justifies only a presumptive diagnosis. Microscopic examination of human tissue for the causative organism is of no diagnostic value as *B. tularense* has not been identified in routine and special preparations. In animal tissue, however, it has been identified, and is found best in the liver of the mouse.

5. Routine laboratory methods are of diagnostic value only from the negative evidence they furnish. Direct examination of material obtained from human lesions is essentially negative. The organism has never been found in smear preparations. Simpson,[5] reporting on 45 cases, obtained positive cultures in 2 cases from human material, using Francis's cystine medium. Otherwise cultures have been essentially negative. The blood picture remains within normal limits except in case of suppuration. Some nephrosis is present, as evidenced by albumin in the urine in mild cases and azotemia in the severer forms. This is of prognostic but not diagnostic value. Negative blood cultures and negative Widal for *B. typhosus* may also be significant negative evidence, as is shown in our third case.

6. The fatal case has several features of interest. Patient was ambulant for six days after onset of symptoms. He died about 20 days after infection. At no time could any lesion be localized that would account for the severity of symptoms and degree of prostration. *B. tularense* was isolated by animal inoculation and culture from the

[5] Annals of Internal Medicine, 1, 12, 1007 (1928).

finger lesion and from sputum ante mortem, and from the heart blood, spleen, liver, and lung post-mortem. The animals developed lesions typical of tularemia and the organism isolated from these various sources was agglutinatd by a known tularemia serum in the titre of 1–1280. Patient's serum developed agglutinins for *B. tularense*, but only in low titre and on last day of illness. The histopathological picture was that of an acute, diffuse, exudative process with coagulative necrosis, with practically no tendency to focal necrosis and proliferation.

7. A fatal ulcero-glandular case, a severe ulcero-glandular case, and a mild typhoidal case resulted from infection with *B. tularense* from a common source.

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## TONGS IN THE TREATMENT OF FRACTURES OF THE TIBIA AND FIBULA

By G. A. Eckert, Lieutenant Commander, Medical Corps, United States Navy

Traction is the accepted and ideal form of treatment for reducing and maintaining in proper position fractures of the long bones; this is particularly true in the femur, humerus, tibia, and fibula.

There are various ways of applying traction, either through some form of adhesive applied to the skin, or by tongs or pins inserted into the bones.

Some years ago Ransohoff urged the use of calipers or tongs applied to the condyles of the femur in the treatment of fractures of the thigh. However, it was not until 1917, when Besley published his article on the use of tongs in the treatment of fractured femurs, that they actually again came into general use. Besley's first caliper was made from meat skewers. The main objection to it was that it penetrated too deeply into the cortex of the bone. Modifications have been made from time to time until a type was produced wherein the penetration of the bone was limited by a screw cap placed on the handles. This is known as the Pearson caliper, and is the one in use at this hospital.

The main object in the use of traction is to overcome the muscle spasm so that the fragments will reduce themselves or be easily reduced. Always keep in mind the fact that it is the muscle force which causes or maintains the displacement. We should treat all fractures as emergencies and try to obtain reduction in as short a time as possible. The longer we delay, the more force is required and the longer it takes for reduction, likewise the period of convalescense is prolonged. Most fractures can be reduced in three or four hours if sufficient weight is used.

Skin traction is usually applied in the form of a Buck's extension, and should be put on the limb so that it extends beyond the point of fracture to the joint above. Many make the mistake of

applying it up to the site of fracture only. When we remember that our primary aim is to relax the muscles of the limb involved, we can well see the reason for extending it above the fracture.

The greatest objection to skin traction is that the adhesive soon becomes detached; the skin becomes excoriated and blistered and, in some cases, the epidermis is actually peeled off. When there is an open wound or when bullæ form beneath the epidermis, it can not be applied and treatment is delayed until healing has taken place. As a result, shortening may occur in the meantime. If the case should finally come to operation, the danger of sepsis is greater. The force must be applied indirectly through the skin, fascia, and ligaments; consequently the pull must be greater than that used in direct or skeletal traction. In muscular patients, it is often impossible to reduce some fractures with skin traction.

Skeletal traction without a doubt represents the highest grade of efficiency in the nonoperative methods of treatment. It is easily applied and can be attached directly to the distal fragments or to one of the bones beyond the joint distal to the fracture. The latter procedure is necessarily not so efficient as the first, because it limits the motion in the joint. The entire surface of the limb is always free for massage and dressings, particularly necessary in compound fractures which require a dressing every day. As has been stated above, the joints are freely movable; this is really a valuable asset when we have once seen how easily the tendons become tied up in adhesions, especially in compound fractures.

When we say that skeletal traction is actually less painful we often see expressions of surprise; nevertheless, it is a true statement. The patient will complain of pain for about 48 hours and may require an opiate the first night; after that he is perfectly comfortable and hardly realizes that he has the tongs in place.

Scudder states that the number of open operations is being somewhat diminished by the increasing use of skeletal traction. Blake says skeletal traction should always be attempted before an operation is judged to be necessary.

Our most valuable adjunct in the treatment of fractures of the long bones is the Thomas splint. Many surgeons regard this as an outcome of the World War; this, however, is not true, as it was written about by Rushton Parker in 1878. It was used extensively in our Army for all first-aid splinting of the lower extremity from the pelvis to the ankle.

Fractures of both bones of the leg until within recent years were looked on with great fear and trepidation. The results from treatment were exceedingly poor. I believe, however, that this is not true at the present day.

The most frequent site of fracture is at the junction of the middle and lower thirds of the bones. The line of fracture is usually oblique, extending from above and downward. The fibula is frequently broken at the same level, but usually it occurs a little higher up. This site is the point where most cases of nonunion occur, due principally to two causes—malposition of soft parts and disturbance of circulation.

Spiral fractures are the most difficult to reduce. They very often will not come into good position with traction and manipulation. Transverse shaft fractures are usually reduced promptly with heavy traction. When the fragments are not end to end, but side to side, they unite slowly and poorly. Oblique fractures are reducible but hard to hold in place. Comminuted fractures are cases for traction, not for open interference; too many pieces of bone are likely to be removed, thus interfering with effective fixation. The result is delayed union at best.

There is nothing original in the method in use at this hospital. It is simply a combination of various procedures which has given us good results. X-ray pictures, anterior-posterior and lateral views, are taken on admission. This gives us an idea of what we have to deal with and how much weight to apply. It also serves as a check during the course of treatment.

The circumference of the thigh is taken at the groin in order that we may know what size ring to use on the Thomas splint. The circumference of the ring should be about 1½ inches greater than that of the thigh. If the ring is too small, it will constrict the structures; this may be a very serious matter if further swelling should take place. If the ring is too large, it will lie in the perineum across the anus and cause much discomfort by pressure on the urethra and interference with defecation. When properly applied it should lie in the fold of the buttocks and press snugly on the tuber ischii. The length of the splint should be about 6 or 8 inches more than the distance from the groin to the heel. The ring is well padded, and adhesive straps are placed at appropriate levels across the side bars to support the limb comfortably. The splint is now put in place. The patient is given a light anesthesia of gas and oxygen, and the tongs are applied with strict aseptic precautions. The point of election for applying the tongs is about 1½ or 2 inches above the tip of the external malleolus—well above the ankle joint. The skin is pulled upwards and put on a stretch, then a small incision is made on either side of the leg about one-fourth inch long. The points of the tongs are inserted into the bones with a few light taps of a mallet. A sterile alcohol dressing is applied and traction by hand started immediately. The patient is returned to his ward and placed on a fracture bed which has a Balkan frame attached. The end of the splint is secured to the crosspiece at the foot of the bed and

traction by means of pulleys and weights applied. Usually about 15 or 20 pounds will be sufficient unless the patient is unusually muscular. A strip of adhesive is placed on the sole of the foot from the heel to the toes and attached to a cord which runs through an overhead pulley. This prevents foot drop. By moving the overhead bar to which the pulley is attached we can also control eversion or inversion of the foot. The first toe, the inner border of the patella, and the anterior superior spine should all be in a straight line. One other thing we must guard against—posterior bowing. These points should be watched daily until union has taken place.

Two of our cases were compound fractures. Some surgeons, after complete débridement, suture the wound up tightly. The technic followed by us was as follows: Tetanus antitoxin was given as soon as the patient reached the hospital. The wounds were thoroughly swabbed out with iodine; the bone ends which were protruding through the wounds were reduced; the edges of the wound were shaved; and the wound left open. A sterile alcohol dressing was applied. Neither case showed any infection, and healed quite rapidly.

Massage of the limb is started early and is continued until the patient is discharged. Motion at the ankle is started immediately, particularly in compound fractures, where there is a marked tendency for the tendons to become adherent not only at the ankle joint, but also over the site of the fracture.

A check X-ray picture is taken on the second or third day. At the end of four weeks the tongs and the Thomas splint are removed and a cast is applied from the toes to the upper thigh. This is split so that the limb can be taken out daily for massage, motion, and ultraviolet light treatments. These stimulate healing. Cod-liver oil seems to aid when healing is sluggish.

Weight bearing is not permitted until 90 days have elapsed, and not then until the X ray shows good bony union. At four months the patient is putting his full weight on the limb. A check should be taken daily when the patient first starts weight bearing to see that there is no tendency toward backward bowing.

The best way to obtain a good functional result is to secure a good anatomical result. If the anatomical result is good, the functional result is good in 90.7 per cent of cases. If the anatomical result be moderate or bad, the functional result is good in 29.7 per cent. If the anatomical result is bad, the functional result is bad in 53.3 per cent. These figures are from a report of the fracture committee of the British Medical Association, 1912.

The plates shown here represent various types of fracture commonly found in the leg.

*Case 1* illustrates the compound oblique-comminuted type of fracture. The patient, who is a farmer, gave a history of being thrown

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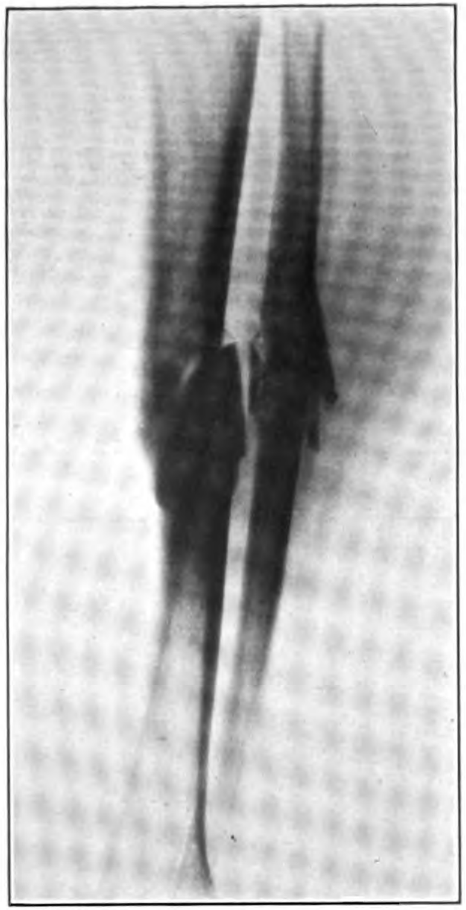


FIG. 1.—CASE 1. COMPOUND OBLIQUE COMMINUTED FRACTURE OF TIBIA AND FIBULA. ANTERO-POSTERIOR VIEW

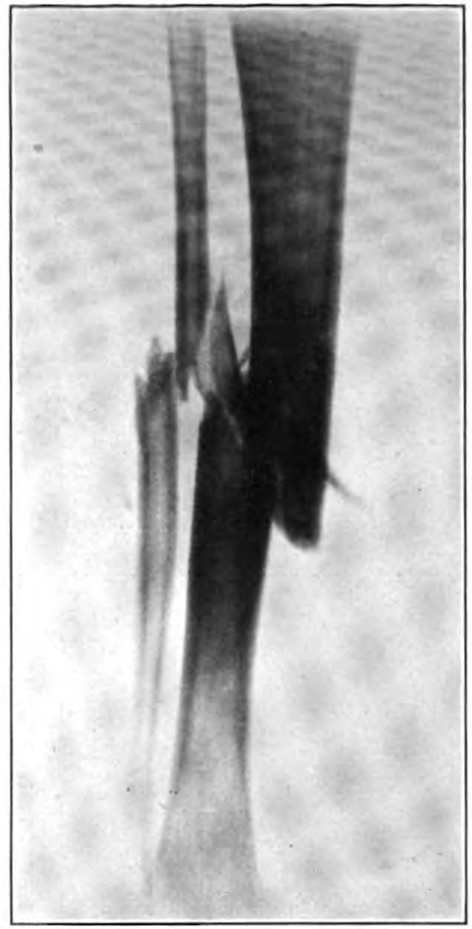
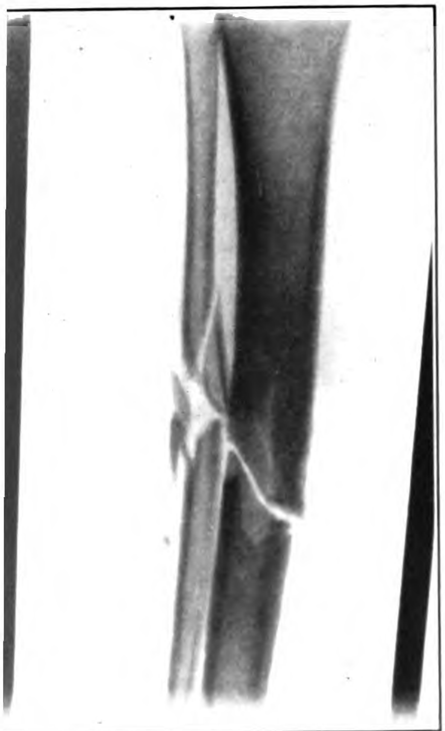


FIG. 2.—CASE 1. LATERAL VIEW



IG. 3.—CASE 1. AFTER APPLYING TRACTION

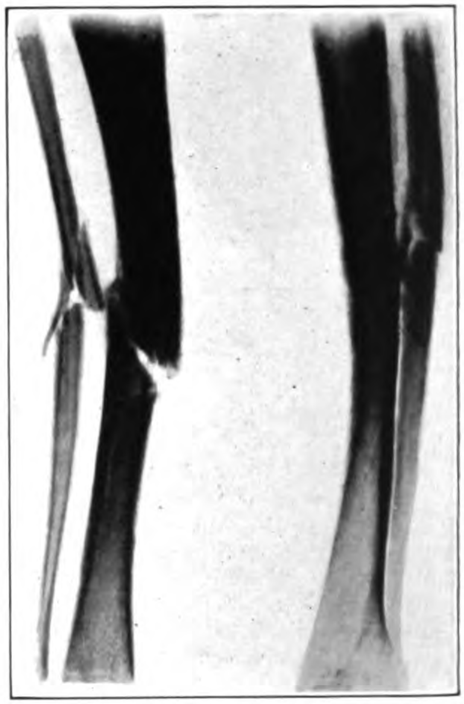


FIG. 4.—CASE 1. FINAL RESULT

IG. 5.—CASE 2. OBLIQUE FRACTURE OF TIBIA AND FIBULA IN LOWER THIRD WITH LONGITUDINAL FISSURING IN TIBIA. ANTERIO-POSTERIOR VIEW

FIG. 6.—CASE 2. LATERAL VIEW

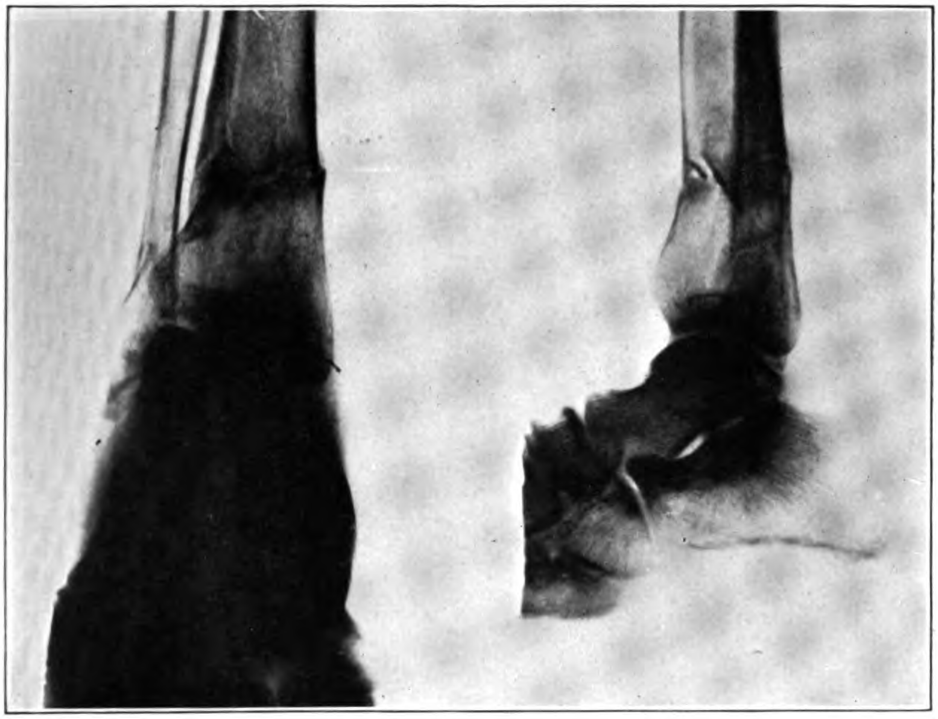


FIG. 7.—CASE 2. FINAL RESULT

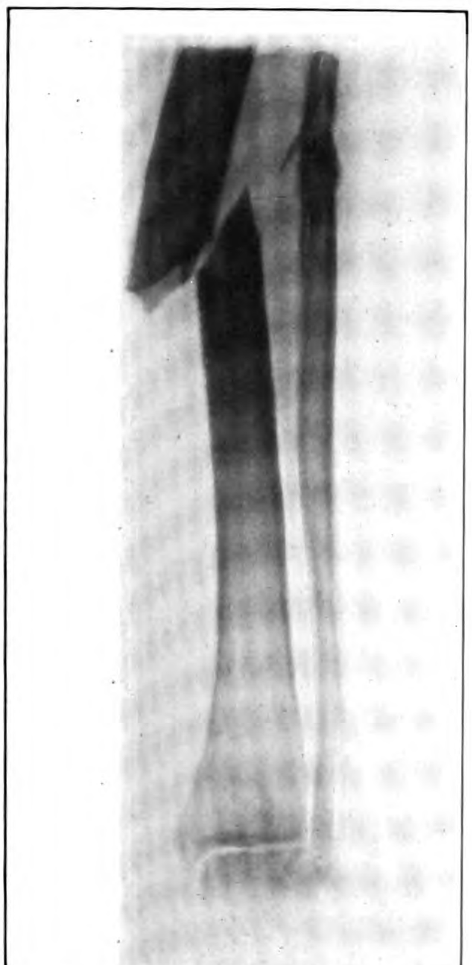


FIG. 8.—CASE 3. OBLIQUE FRACTURE OF TIBIA AND FIBULA. TIBIA BROKEN AT DIFFERENT LEVELS. ANTERO-POSTERIOR VIEW

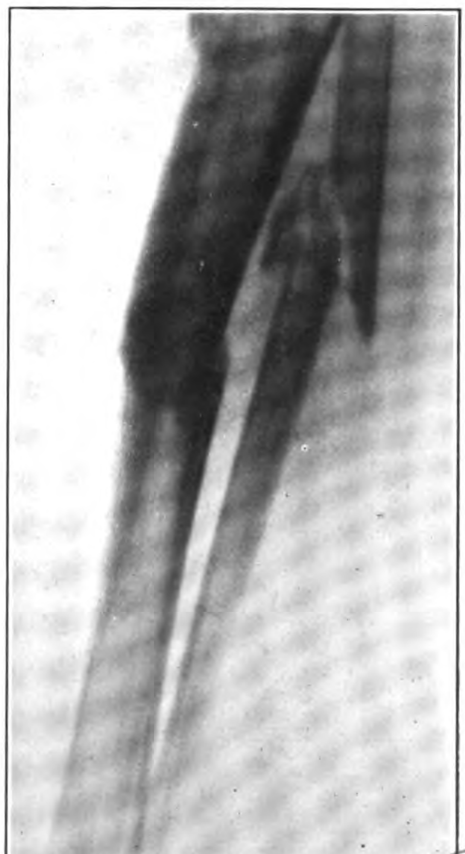


FIG. 9.—CASE 3. LATERAL VIEW

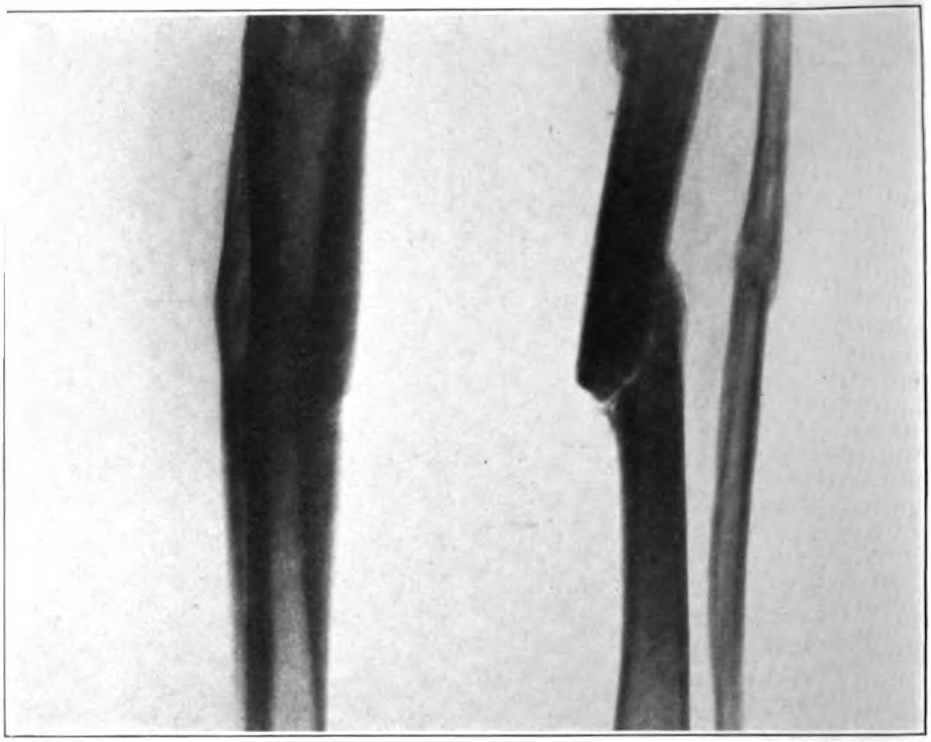
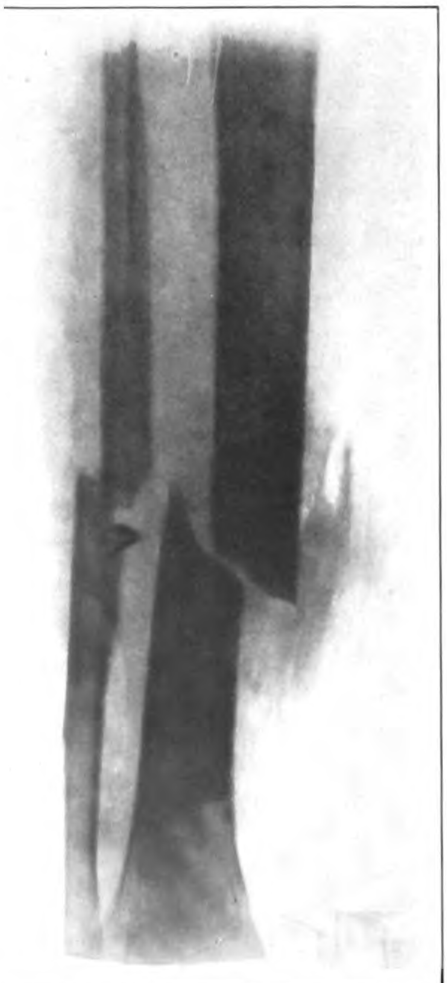


FIG. 10.—CASE 3. FINAL RESULT



'IG. 11.—CASE 4. COMPOUND OBLIQUE TRANSVERSE FRACTURE OF TIBIA AND FIBULA. ANTERO-POSTERIOR VIEW

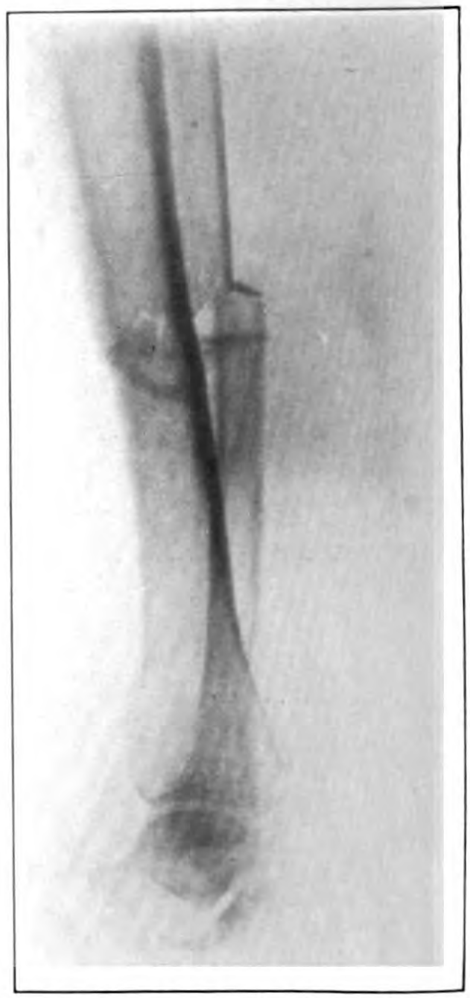


FIG. 12.—CASE 4. LATERAL VIEW

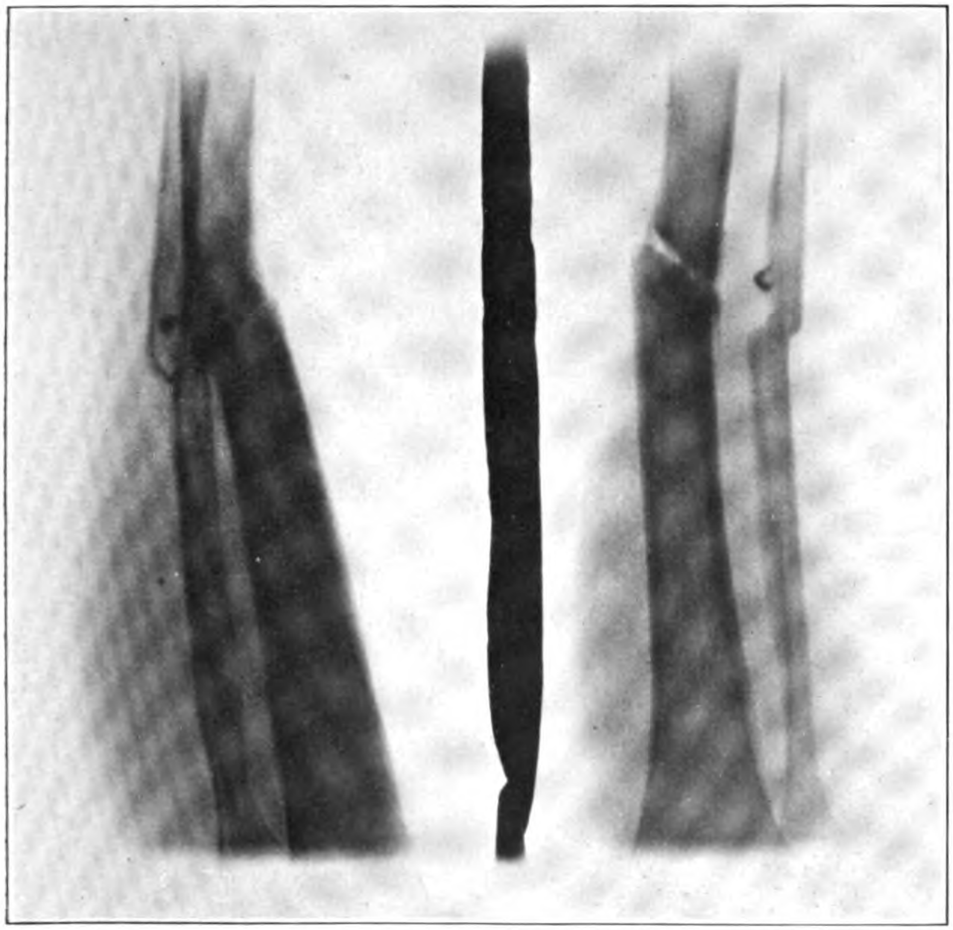


FIG. 13.—CASE 4. FINAL RESULT

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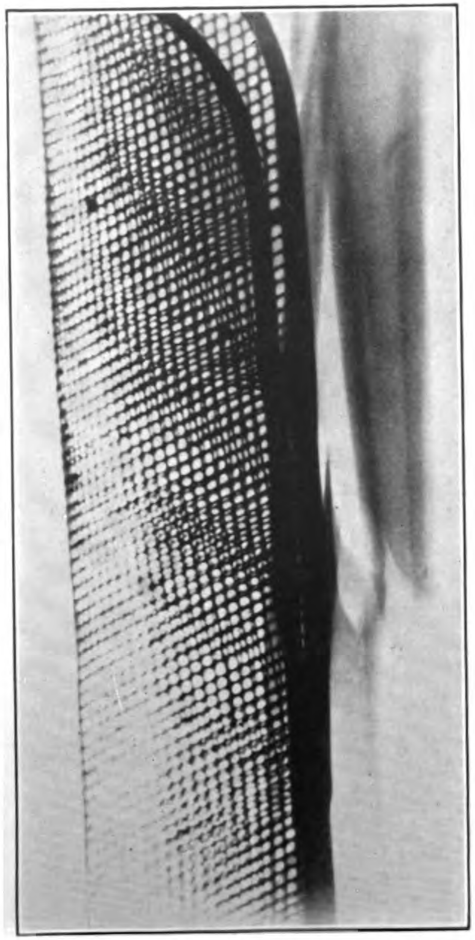

FIG. 14.—CASE 5. SPIRAL OBLIQUE FRACTURE OF TIBIA AND FIBULA. THE FIBULA IS BROKEN HIGH UP. ANTERO-POSTERIOR VIEW

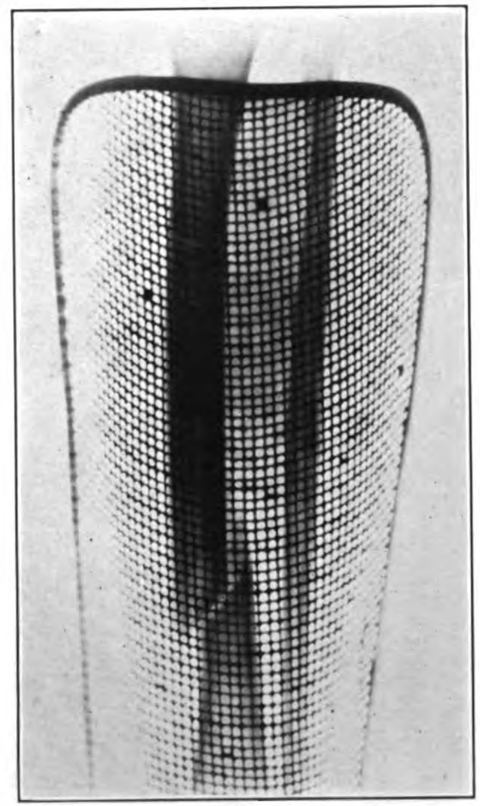

FIG. 15.—CASE 5. LATERAL VIEW

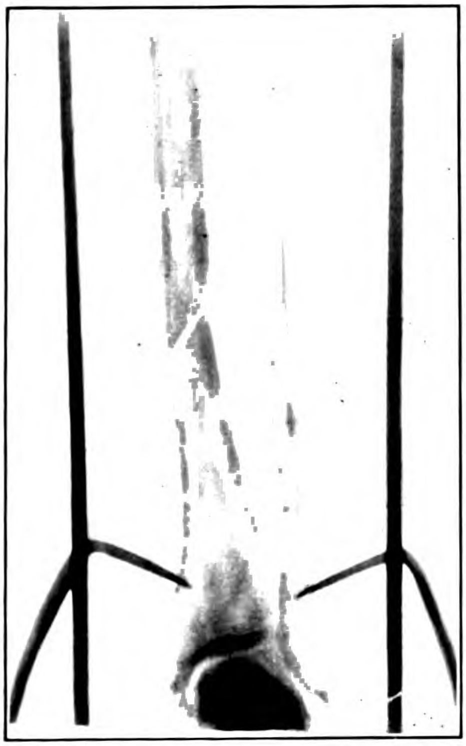

FIG. 16.—CASE 5. ANTERO-POSTERIOR VIEW WITH TONGS IN PLACE

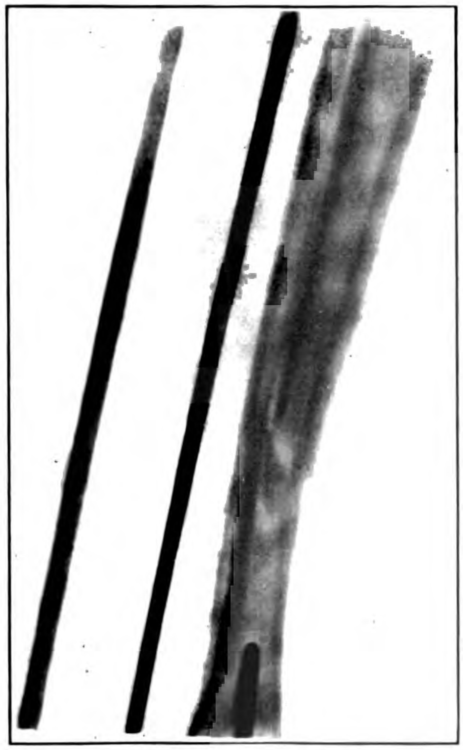

FIG. 17.—CASE 5. LATERAL VIEW WITH TONGS IN PLACE

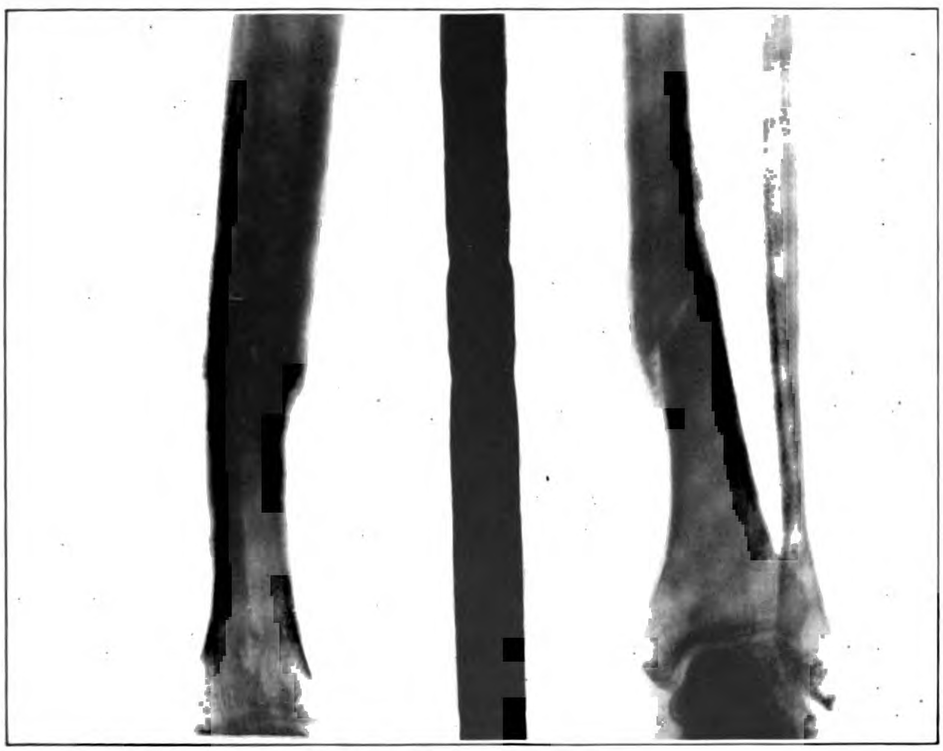

FIG. 18.—CASE 5. FINAL RESULT

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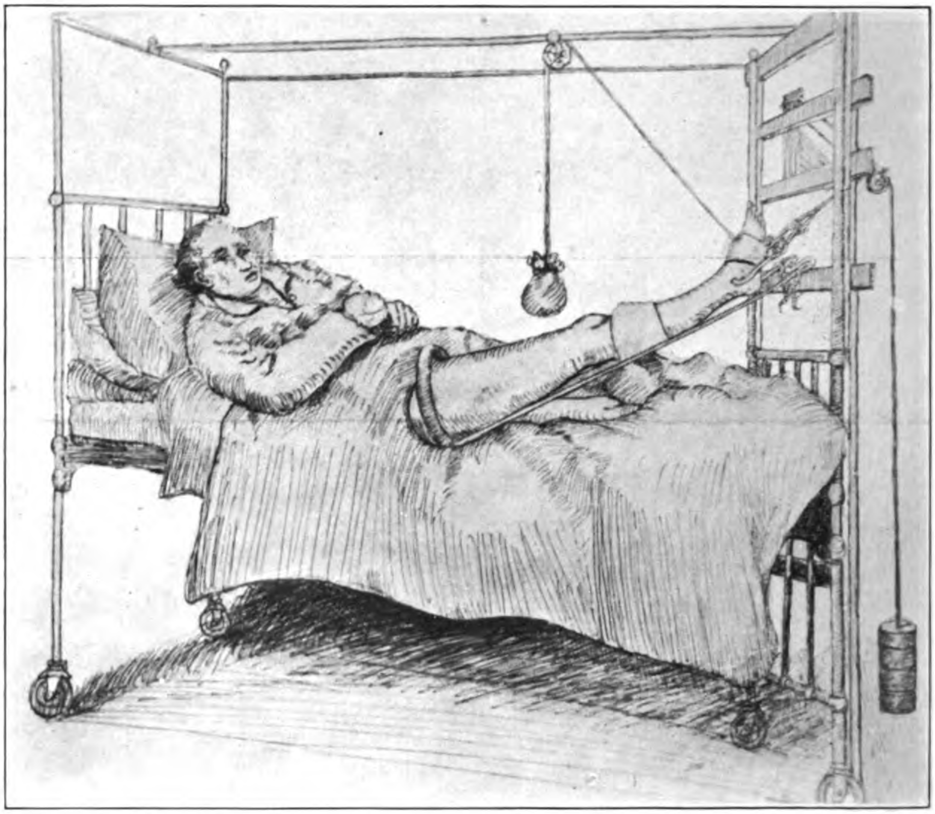

FIG. 19.—THOMAS SPLINT AND EXTENSION APPARATUS IN PLACE

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from a light farm wagon when his horse ran away. He was first seen by his family physician who applied first-aid measures and immediately transferred him to this hospital in an automobile—a distance of about 120 miles. He arrived here about 10 hours after the accident.

On admission the tibia was protruding through the wound and a part of his clothing was caught between the ends. The X-ray plates show the condition on admission, the position of the bones after traction was applied, and the condition on discharge.

*Case 2* illustrates an oblique fracture of the tibia and fibula in the lower third of the bone. It also shows longitudinal fissuring of the tibia. We considered this a good case in which to apply the tongs to the os calcis because the fractures were so low and there was considerable danger of having the tongs slip into the joint. This is the only case in our series where we applied them below the ankle. As has been stated before, this is not so efficient, mainly because it interferes with motion at the ankle.

The patient gave a history of having a load of lumber slip from a hoisting crane and fall on his lower leg.

*Case 3* illustrates an oblique fracture of the tibia and fibula with the tibia fractured at different levels. One valuable lesson to be learned here is to take a picture of the entire leg from the knee downward. Our first plate showed only one fracture in the tibia. Clinically, we felt that there was another higher up—a later picture showed this.

This was a very difficult case to handle. We were not at all optimistic concerning the final results.

The patient was a floor man in one of the large department stores—age 55. He was not in any too good physical condition. He gave a history of falling down a flight of stairs. We received him at this hospital about 24 hours after the accident. The leg was then swollen, edematous, and painful. It had numerous areas of ecchymosis and bulla formation.

We felt duly repaid when this patient was discharged with a good functional and anatomical result.

*Case 4* illustrates a compound oblique-transverse fracture of the tibia and fibula. He gave a history of falling through an open hatch to the deck below, a distance of about 30 feet.

On admission the distal end of the proximal fragment was protruding and riding on the skin. There was considerable bleeding from a branch of the anterior tibial artery. The nerve was not injured. The wound was made larger, vessels tied off, and the protruding bone end reduced. As would be expected, union was sluggish.

*Case 5* illustrates a spiral oblique fracture of the tibia and fibula. The site of fracture in the fibula is near the knee joint. It can be seen at the upper border of the wire splint.

This case gave the typical history of this type of fracture—force combined with a twist. He fell on the ice with the leg twisted under him.

The plates show the proper position for application of the tongs.

### Summary

Skeletal traction is more efficient than skin traction and in many cases takes the place of open operation.

Skeletal traction should always be tried before deciding on operation. Allow at least two weeks. If union has not started by that time, consider operation.

Guard against backward bowing in fractures of both bones of the leg. This is the most frequent deformity, especially when the fracture is in the middle and lower thirds. A little shortening or inaccuracy in the line makes very little difference in use.

The Thomas splint when properly applied is one of the greatest adjuncts in the treatment of fractures of the long bones.

Many surgeons object to skeletal traction because they fear resulting osteomyelitis. In our series we have had none. All the wounds healed promptly when the tongs were removed.

If operation is deemed necessary, use the sliding bone graft.

We frequently hear the remark, "The treatment of fractures has not progressed in the past 100 years or more." I believe that day is passing. We are gradually getting better results and surgeons are becoming more and more interested in this interesting and so-called neglected branch of surgery—the treatment of fractures.

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## SPINAL FLUID IN TROPICAL SYPHILIS [1]

By R. P. Parsons, Lieutenant Commander, Medical Corps, United States Navy

In Haiti, where syphilis is perhaps more prevalent than in any other country in the world, it is a remarkable fact that tabes and paresis are unknown.

In trying to arrive at some sort of explanation for this curious situation, the problem has been considered from various angles and some very interesting facts have presented themselves.

[1] Read before the Second Congress of Medicine in Haiti, May 8, 1928.

It has been suggested, for example, that the increase of paresis in the United States might be the result of the greatly increased use of the arsenicals and other antiluetic agents during the past decade. On this hypothesis it has been thought possible that the absence of paresis in Haiti has been due to the complete absence of treatment there until a few years ago. It would seem, however, that this theory may be dismissed, when it is considered that the arsenicals and bismuth have been poured into the Haitian population at a rapidly increasing rate during the last five years until the rate has now reached the point of a half million injections per year, and no case of paresis has yet appeared. A few thousand individuals have received very intensive courses of treatment there, and the mass has received enough treatment to have brought about a striking change in the general picture—a marked decline in the incidence of the disease and the general disappearance of external lesions, which formerly met the eye on every hand.

From year to year we have become increasingly impressed with the notable similarity of the country's two great disease groups, yaws and syphilis, which, if considered together, are practically universal for the Haitian population. It has been held that lesions of the central nervous system do not exist in Haiti because the Haitian disease is yaws and not syphilis. But the disease, as found in the cities, does not differ in any way (except for the absence of tabes and paresis) from the syphilis of the United States, and our accumulation of autopsy and clinical records now shows that the rural nonvenereal form of the disease known as yaws is capable of producing in Haitians all the lesions that syphilis can produce, including those that the textbooks attribute to syphilis only.

We can hardly explain the nonoccurrence of neurosyphilis on a racial immunity basis, brought about by many generations of yaws infections, since there is no racial difference between the town and rural native, and yet the town person contracts the venereal form and the mountain person the nonvenereal form of the disease. Moreover, there is no racial difference between the Haitian negro and the American negro, and we know that neurosyphilis certainly does not spare the American negro.

As for the theory that the "Haitian strain" of the spirochete is one which does not attack the central nervous system, we have only to point to the large number of marines and sailors who contract syphilis in Haiti and later develop paresis after their return to the United States.

In the light of results obtained in recent years by the malarial treatment of paresis, an explanation is suggested which seems to fit perfectly the conditions found in Haiti.

There is scarcely an inhabitant of the island who is not being frequently reinfected with malignant malaria. It has only been within the last two or three years that even Port au Prince, the capital and largest city, has become relatively free from malaria. In all other localities it is rare indeed that one can remain so long as a year without becoming infected. Extensive malaria surveys conducted during the past year reveal parasites in the blood of from 40 per cent to 90 per cent of the inhabitants in the various localities. The actual percentage that is infected is of course higher than that which happens to show parasites in a single blood smear. Now, if we consider that here the malaria is the malignant form, that it is universal, and that it is in general inadequately treated, it seems most reasonable to suppose that this may very well account for the non-appearance of cases of paresis and tabes.

It was thought that much information would be gathered on this subject by the study of the spinal fluid of cases of syphilis and yaws—not only from the standpoint of the possible malarial effect on these fluids, but also to determine whether there is any essential difference in those two varieties of the disease as regards spinal fluid findings. As noted above, we have concluded that pathologically, at least, one can find no difference whatever in these two varieties of the disease in Haiti.

A group of 33 cases of typical yaws ranging in duration from 1 month to 30 years was examined as to blood Wassermann, spinal-fluid findings, neurological lesions, malarial histories, and blood smears for malaria. A group of 30 typical city syphilitic cases, ranging in duration from 2 months to 30 years, mostly residents of Port au Prince, was similarly examined for comparison, particularly in regard to spinal-fluid findings.

The ages of the cases ranged from 5 years to 43 years for the yaws group and from 21 years to 69 years for the syphilis group. Three of the yaws cases denied malarial history, and in these three cases the blood smears were negative for parasites. In each of the syphilitic cases there was a history of attacks of chills and fever. Thirty-six per cent of the yaws cases and 18 per cent of the syphilitic cases had positive malaria blood smears on a single examination. As to neurological findings, among the yaws cases, 2 had severe headaches and 1 was deaf; among the syphilitic cases, 1 had a flaccid paraplegia, 1 a spastic paraplegia, 1 ataxia of lower extremities without pupillary changes or other signs of tabes, 1 was deaf, 1 suffered from pains characteristic of a neuritis, and 1 was a hemiplegic. Curiously, none of these cases except the hemiplegic had a positive spinal fluid although three others among the syphilitics without neurological symptoms did have positive fluids.

TABLE I.—*Yaws cases*

| Case No. | Age | Duration | Color | Lesion | Malarial | | Neurological | Previous treatment | Blood | Spinal fluid | | Globulin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | History | Smear | | | | Wasserman | Cells | |
| 1 | 8 | 8 months | Brown | Papular rash | Positive | Positive | Negative | 0 | 4 plus | Negative | 5 | Negative |
| 2 | 40 | do | do | do | do | Negative | do | 0 | do | do | 7 | Do. |
| 3 | 45 | 1 year | do | Palmar and plantar extremities. | do | do | do | 0 | do | do | 17 | Do. |
| 4 | 15 | 1 month | do | Primary, on chin | do | Positive | do | 0 | do | do | 5 | Do. |
| 5 | 15 | 3 months | do | Papular rash | do | Negative | do | 0 | do | do | 2 | Do. |
| 6 | 10 | 1 year | do | do | Negative | do | do | 0 | do | do | 10 | Do. |
| 7 | 15 | 2 year | do | Ulcer foot | Positive | do | do | 0 | do | do | 7 | Do. |
| 8 | 22 | 2 months | Light brown | Papular rash | do | Positive | do | 0 | 3 plus | do | 2 | Do. |
| 9 | 16 | 3 months | Black | Condylomata | do | do | do | 0 | 4 plus | do | 5 | Do. |
| 10 | 35 | 1 year | do | do | do | Negative | do | 0 | do | do | 5 | Do. |
| 11 | 30 | 3 months | do | Primary, on lip | do | do | do | 0 | do | do | 2 | Do. |
| 12 | 22 | 9 months | Brown | Ulcer breast | do | Positive | do | 0 | do | do | 5 | Do. |
| 13 | 20 | 3 years | Light brown | Ulcer arm | do | Negative | do | 0 | do | do | 2 | Do. |
| 14 | 9 | 2 years | Brown | Many ulcers | do | do | do | 1 injection, bismuth | do | do | 5 | Do. |
| 15 | 30 | 3 months | do | Ulcer leg | do | Positive | do | 0 | do | do | 7 | Do. |
| 16 | 5 | 3 years | Black | None. Deaf | Negative | Negative | Deafness | 0 | do | do | 24 | Do. |
| 17 | 35 | 6 months | do | Pustule, on foot | Positive | Positive | Negative | 2 injections, bismuth | do | do | 15 | Do. |
| 18 | 7 | 1 month | do | Primary, on leg | do | do | do | 0 | do | do | 5 | Do. |
| 19 | 17 | 6 months | do | Pustular rash | do | Negative | do | 0 | do | do | 42 | Do. |
| 20 | 35 | 5 months | do | do | do | do | do | 0 | do | do | 9 | Do. |
| 21 | 30 | 25 years | do | Periostitis, rib | do | do | do | 1 injection, bismuth | do | do | 5 | Do. |
| 22 | 40 | 30 years | Brown | None | do | do | Headache, 2 years | do | do | do | 9 | Do. |
| 23 | 30 | 20 years | Black | do | do | Positive | Negative | 0 | do | do | 12 | Do. |
| 24 | 28 | 15 years | do | do | do | Negative | Headache, 2 years | 0 | do | do | 4 | Do. |
| 25 | 25 | 3 years | do | Ulcer, foot | do | do | Negative | 0 | do | do | 4 | Do. |
| 26 | 14 | 5 years | do | Crab | do | Positive | do | 0 | do | do | 10 | Do. |
| 27 | 10 | 1 year | do | Periostitis ulcer | Negative | Negative | do | 2 injections, bismuth | do | do | 24 | Do. |
| 28 | 25 | 7 years | Brown | Crab | Positive | Positive | do | 3 injections, bismuth | 2 plus | do | 25 | Do. |
| 29 | 8 | 2 years | Black | None. Primary, scar on foot. | do | Negative | do | 0 | 4 plus | do | 3 | Do. |
| 30 | 13 | 4 years | do | Crab | do | do | do | 2 injections, bismuth; 2 neoarsphenamine. | do | do | 8 | Do. |
| 31 | 13 | 5 years | do | None. Primary scars | do | Positive | do | 0 | do | do | 40 | Do. |
| 32 | 31 | 10 years | do | Ulcer leg | do | Negative | do | 1 injection, bismuth; 1 neoarsphenamine. | 3 plus | do | 3 | Do. |
| 33 | 18 | 6 years | do | do | do | do | do | 30 injections, bismuth | 4 plus | do | 4 | Do. |

TABLE II.—*Syphilitic cases*

| Case No. | Age | Duration | Color | Lesion | Malarial | | Neurological | Previous treatment | Blood | Spinal fluid | | Globulin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | History | Smear | | | | Wassermann | Cells | |
| 34 | 38 | 20 years | Brown | Pustular eruption | Positive | Negative | Negative | 6 injections neoarsphenamine, 6 hydrargyrum. | 4 plus | Negative | 8 | Negative. |
| 35 | 25 | 2 months | Black | Chancre | do | do | do | 0 | do | 4 plus | 18 | Do. |
| 36 | 20 | 3 months | do | do | do | do | do | 2 injections neoarsphenamine. | do | Negative | 10 | Do. |
| 37 | 35 | 2 months | do | do | do | do | do | do | do | do | 13 | Do. |
| 38 | 37 | 20 years | Brown | See neurological | do | do | Flaccid paralysis lower extremities. | 10 injections neoarsphenamine. | 3 plus | do | 15 | Do. |
| 39 | 47 | 11 years | Light brown. | Aortic aneurysm | do | Positive | Negative | 0 | 2 plus | do | 2 | Do. |
| 40 | 50 | 20 years | Black | Myocarditis | do | do | do | 2 injections neoarsphenamine. | 4 plus | do | 3 | Do. |
| 41 | 55 | 30 years | do | do | do | Negative | do | do | 3 plus | do | 5 | Do. |
| 42 | 21 | 2 years | do | Nephritis | do | Positive | do | do | do | do | 6 | Do. |
| 43 | 23 | 3 years | do | See neurological | do | Negative | Spastic para plegia | 4 injections neoarsphenamine. | 4 plus | do | 4 | Do. |
| 44 | 69 | 30 years | do | Aortitis | do | do | Negative | 5 injections neoarsphenamine. | do | do | 3 | Do. |
| 45 | 45 | 5 years | do | See neurological | do | do | Ataxia lower extremities. | 4 injections bismuth | 3 plus | do | 4 | Do. |
| 46 | 50 | 20 years | do | Aortitis | do | do | Negative | 3 injections bismuth | 4 plus | do | 6 | Do. |
| 47 | 56 | 16 years | do | None. History of chancre. | do | Positive | do | 5 injections bismuth | do | do | 16 | Do. |
| 48 | 50 | 4 years | Brown | Aortitis | do | Negative | do | 3 injections neoarsphenamine. | do | 4 plus | 12 | Do. |
| 49 | 20 | 7 months | Black | Chancre scar | do | do | do | 0 | do | Negative | 10 | Do. |
| 50 | 40 | 2 years | Brown | Pustular eruption | do | do | do | 1 injection neoarsphenamine. | do | do | 1 | Do. |
| 51 | 35 | 8 years | Black | Chancre scar | do | do | Rheumatic pains | 3 injections neoarsphenamine. | do | do | 8 | Do. |
| 52 | 24 | 3 months | Brown | Chancre | do | Positive | Negative | 2 injections bismuth | do | do | 3 | Do. |
| 53 | 49 | 30 years | do | Aortitis | do | Negative | do | 12 injections hydrargyrum. | do | do | 0 | Do. |
| 54 | 50 | 17 years | Black | See neurological | do | do | Deafness | 0 | do | do | 6 | Do. |
| 55 | 30 | 4 years | Brown | Chancre scar | do | do | Negative | 0 | do | 4 plus | 5 | Do. |
| 56 | 35 | 3 months | Yellow | Chancre | do | do | do | 1 injection neoarsphenamine. | do | Negative | 30 | Do. |
| 57 | 48 | 20 years | Black | See neurological | do | do | Hemiplegia | 3 injections neoarsphenamine, 1 hydrargyrum. | 3 plus | 4 plus | 10 | Do. |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58 | 25 | 5 months | do | Pustular eruption | do | Positive | Negative | 7 injections bismuth, 2 injections neoarsphenamine. | 4 plus | Negative | 6 | Do. |
| 59 | 22 | do | Brown | Chancre scar | do | Negative | do | 3 injections neoarsphenamine. | do | do | 6 | Do. |
| 60 | 22 | 2 years | Black | do | do | do | do | 0 | do | do | 8 | Do. |
| 61 | 38 | 3 years | do | do | do | do | do | 0 | 2 plus | do | 6 | Do. |
| 62 | 18 | 2 months | do | Macular eruption | do | do | do | 0 | 4 plus | do | 6 | Do. |
| 63 | 48 | 6 years | do | Chancre scar | do | do | do | 5 injections neoarsphenamine, 5 hydrargyrum. | do | do | 4 | Do. |

TABLE III.—*Summary*

| | Yaws | Per cent | Syphilis | Per cent |
|---|---|---|---|---|
| Age | 5 to 45 years | | 21 to 60 years | |
| Duration | 1 month to 20 years | | 2 months to 30 years | |
| Color of patient | Light brown, 2 | 6 | 2 | 7 |
| | Brown, 12 | 36 | 8 | 27 |
| | Black, 19 | 57 | 20 | 66 |
| Malaria: | | | | |
| History | Positive, 30 | 90 | 30 | 100 |
| Smear | Positive, 12 | 36 | 5 | 18 |
| Neurological symptoms | 3 | 9 | 6 | 20 |
| Previous treatment | 9 | 27 | 25 | 80 |
| Blood Wassermann | Positive, 33 | 100 | 30 | 100 |
| Spinal-fluid Wassermann | Positive, 0 | 0 | 4 | 13 |
| Cell count above normal | 8 | 24 | 6 | 20 |
| Increased globulin | 0 | 0 | 0 | 0 |

### CONCLUSIONS

(1) In "Tropical syphilis," at least in Haiti, the only essential difference that exists between so-called yaws and syphilitic varieties lies in the site and nature of the primary lesion.

(2) Apparently the syphilitic type shows a great number of positive spinal fluids, but the groups used in this study were too small to make any conclusion very definite in this regard.

(3) Cord lesions not those of tabes occurred among the syphilitic group, but many similar lesions have been noted among yaws cases in Haiti before this study was begun.

(4) At present the most logical explanation of the nonappearance of tabes and paresis in Haiti, where syphilis is universal, lies in the fact that malaria is also universal in that country.

## PAROXYSMAL TACHYCARDIA OF HIGH BUNDLE BRANCH ORIGIN WITH INDEPENDENT AURICULAR RHYTHM

### REPORT OF CASE[1]

By D. FERGUSON, Lieutenant Commander, Medical Corps, United States Navy

This case is reported because of the following unusual features: (*a*) Electrocardiograms which showed a supraventricular type of paroxysmal tachycardia with an independent auricular rhythm; (*b*) history of gradual onset of the tachycardia; (*c*) the unusual effects of vagal pressure which consistently slowed the ventricular rate but did not stop the tachycardia; (*d*) the difficulty of determining the origin of the tachycardia.

The patient, a salesman, aged 40, was admitted to the hospital complaining of rapid heart action, weakness, dyspnea, and orthopnea

[1] From the Medical Service of the U. S. Naval Hospital, Chelsea, Mass.

of six days' duration. The attack was precipitated by running for a street car. On repeated questioning he constantly asserted the heart rate gradually increased in rate over a period of several hours. The weakness and dyspnea had gradually increased.

A previous attack of rapid heart action and weakness occurred three months previously but subsided spontaneously after three days' rest in bed. This attack was also precipitated by unusual exertion; the rapid heart rate was gradually attained but subsided suddenly, probably in one cardiac cycle.

The family history was irrelevant but the past history revealed an adequately treated syphilis contracted in 1920 and a single attack of acute rheumatic fever in 1926.

Physical examination was essentially negative except for the heart. The cardiac outlines were within normal limits. The apical rate was 196, the radial rate 100. The rhythm was regular. The blood presure was 100 over 90. The patient was moderately orthopneic but there was no evidence of congestive heart failure. A diagnosis was made of paroxysmal tachycardia, probably auricular, and electrocardiograms were made before any treatment was instituted. (Figure A.)

### Course and Treatment

For 48 hours the attempt was repeatedly made to cause reversion to normal rhythm through vagus stimulation by massage over the carotid sheath, by ocular pressure, through the abdominal vagus fibers by cold and hot drinks, and through the pulmonary fibers by forced respiratory efforts.

They were all unsuccessful, but pressure over the carotid sheath consistently slowed the heart; on one occasion the rate was reduced from 195 to 164. Unfortunately, curves showing the effects of vagus pressure were not obtained, but Figure F shows the tachycardia with a ventricular rate about 166. The patient then was given a trial dose of quinidine; no ill effects were noted and 6 grains every three hours for five doses per day were administered. Following two days of treatment the heart reverted to normal rhythm during the night. For a few days a reduced dosage of quinidine was given and then the drug was stopped.

During the remainder of his stay in the hospital the rhythm remained normal and the patient was discharged symptom free; the response to a cardiac functional test was normal. A teleröntgenogram showed the heart size not enlarged and the Kahn test was negative repeatedly. No definite evidence of organic heart disease could be elicited, except the anomalous electrocardiogram suggestive of intraventricular block. (Fig. B.)

### Comment

Figure C shows the tracing obtained a year previously during the attack of rheumatic fever. It demonstrates the importance of repeated electrocardiographic observation of patients who have had rheumatic fever, even though the rheumatism is contracted at an age period when cardiac complications are relatively infrequent.

The history of the onset of a tachycardia is most important. A sudden onset of the rapid rate, occurring in one cycle, is characteristic of paroxysmal tachycardia. This patient repeatedly stated that the heart rate gradually increased until the rapid rate was attained; this history is typical of sinus or normal tachycardia.

In paroxysmal tachycardia, vagus stimulation abolishes the abnormal rhythm. In this patient vagus stimulation slowed the heart repeatedly, thus exerting the same effect as occurs in hearts with normal rhythm.

This paroxysmal tachycardia was first believed to be of nodal origin. The slightly aberrant ventricular complexes could be the result of the rapid rate.[2] The inverted P, appearing after the initial ventricular deflection, as occurs in nodal tachycardia, could not be present with an independent auricular rhythm.

The unusual systolic intervals in Figure A, regularly alternating between 0.30 and 0.34 second, do not occur in either auricular or ventricular tachycardia. It does not seem that the regularly falling auricular complex causes this alternation through refractory period effects in the bundle, as the systolic interval in Figure F is quite constant at 0.34 seconds. This regularity does not occur in paroxysmal ventricular tachycardia.[3]

### Subsequent Course

Figure D shows electrocardiograms obtained five months after those in Figure A were made. The premature beat partakes quite equally of the characteristics of a supra-ventricular and a ventricular extrasystole. On reexamination of Figure A this same aberrant type of complex is identified.

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## STRANGULATED DIAPHRAGMATIC HERNIA

### Report of Case

By J. W. Ellis, Lieutenant Commander, Medical Corps, United States Navy

In presenting this report it is not the intention to review the subject thoroughly nor to discuss the types and the causative factors.

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[2] White, P. D. and Stevens, H. W.: Ventricular response to auricular premature beats and to auricular flutter. Arch. Int. Med., 18, November, 1916.

[3] Strong, G. F., and Levine, S. A.: The irregularity of the ventricular rate in paroxysmal ventricular tachycardia. Heart, 10; 125, April, 1923.

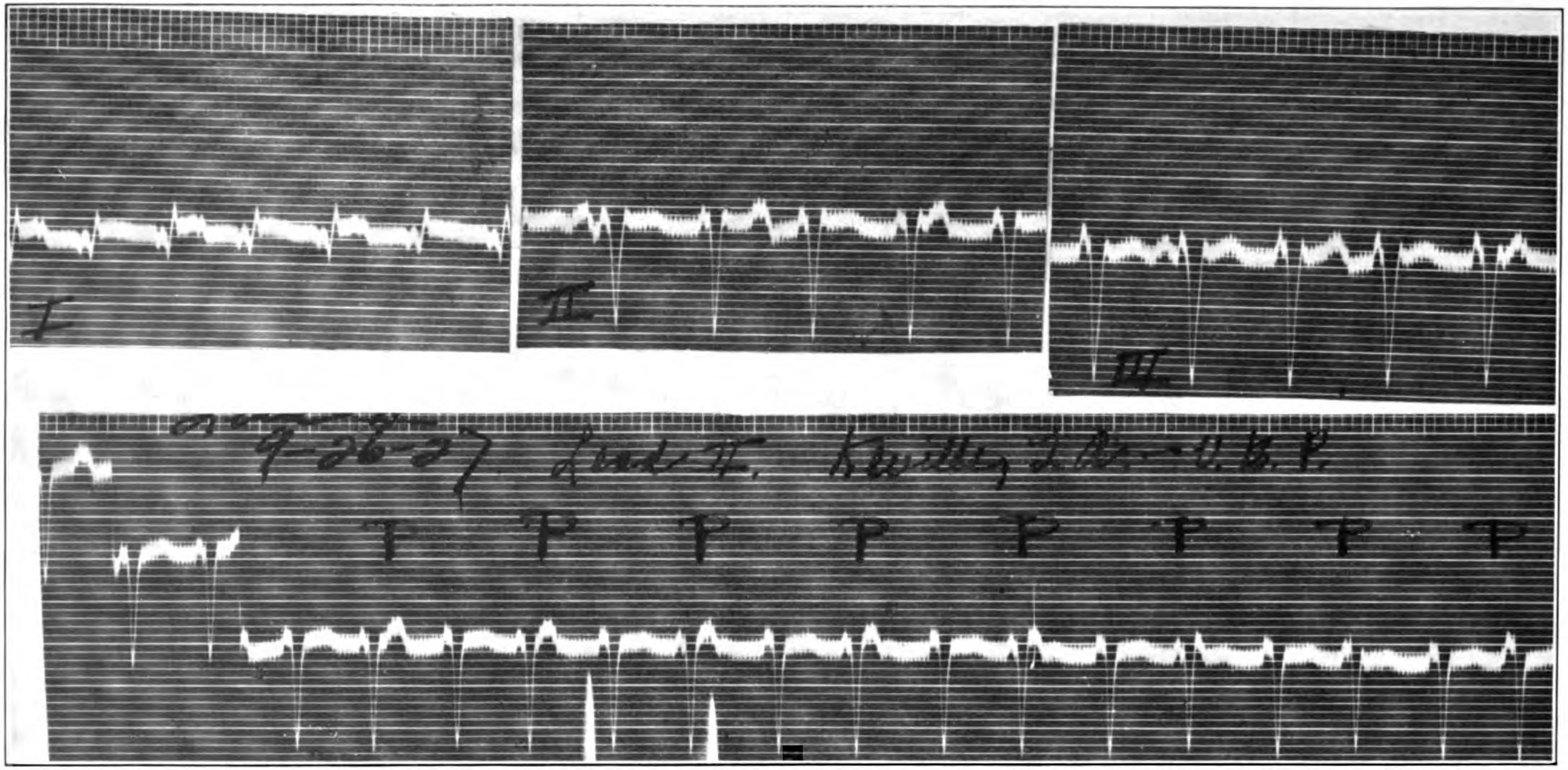


FIG. A.—ABOVE: LEADS 1, 2, AND 3 DURING PARAXYSM. BELOW: LEAD 2. AURICULAR RATE ABOUT 94; VENTRICULAR RATE ABOUT 188. THE P WAVES ARE MARKED. THE INTERVALS BETWEEN S MEASURE 0.30 AND 0.34 SECONDS ALTERNATELY. AN APPEARANCE OF GREATER IRREGULARITY IS DUE TO A FASTER CAMERA SPEED NEAR THE FIRST MARKED P

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924—2

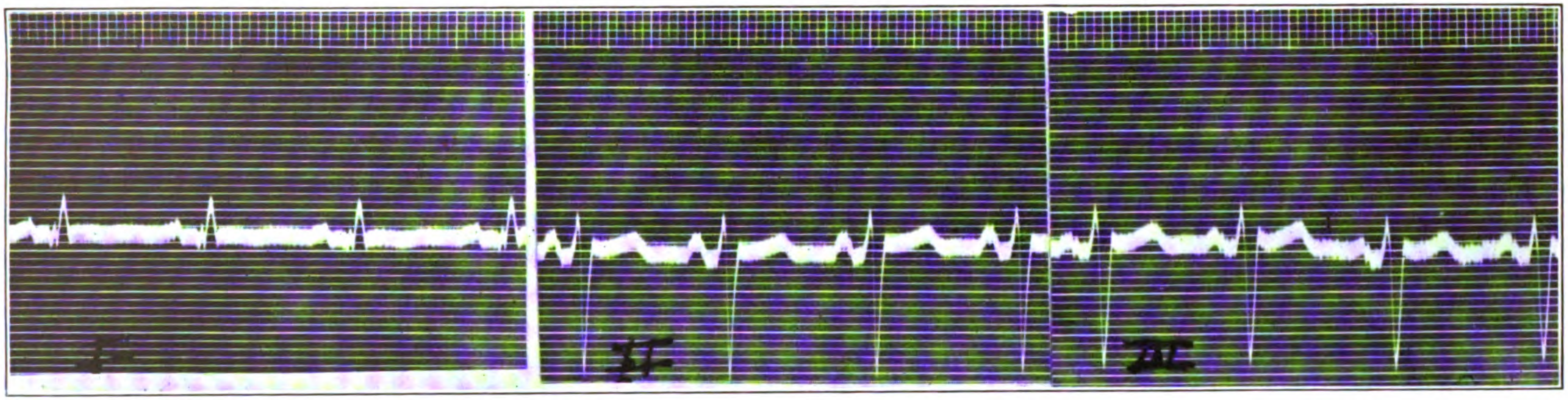

FIG. B.—LEADS 1, 2, AND 3 AFTER NORMAL RHYTHM WAS RESTORED

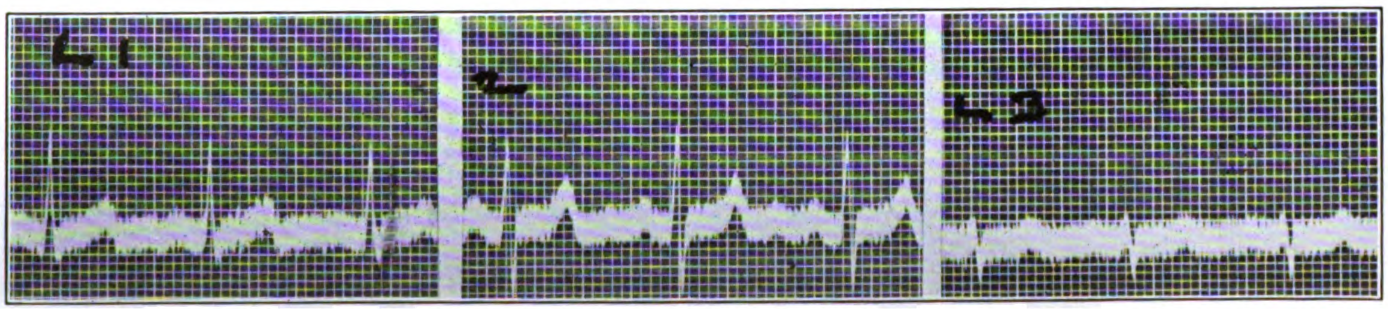

FIG. C.—LEADS 1, 2, AND 3 TAKEN A YEAR PREVIOUSLY DURING AN ATTACK OF RHEUMATIC FEVER

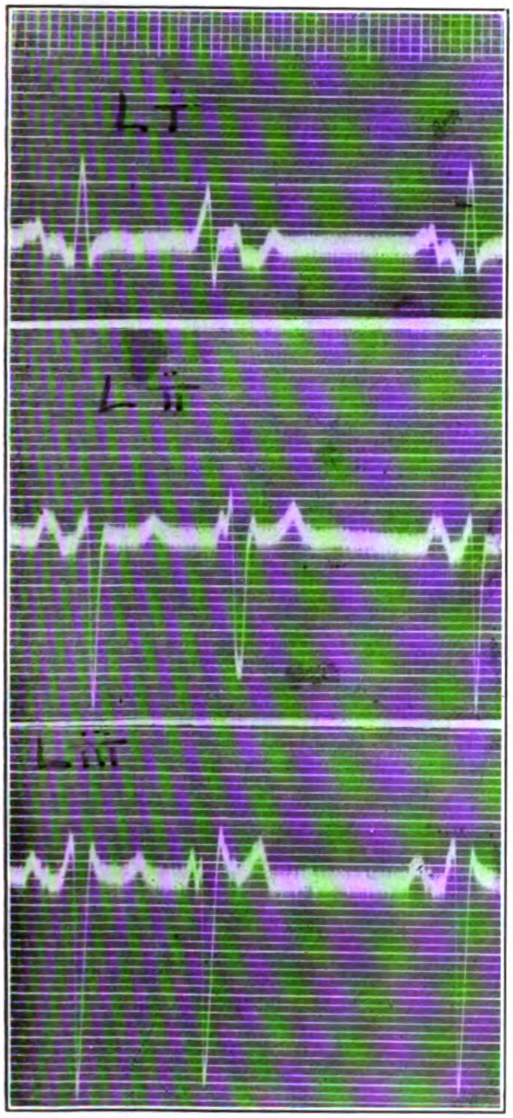

FIG. D.—LEADS 1, 2, AND 3 TAKEN FIVE MONTHS AFTER TACHYCARDIA SHOWN IN FIGURE A. THE PREMATURE BEAT IS SHOWN BETWEEN TWO NORMAL COMPLEXES

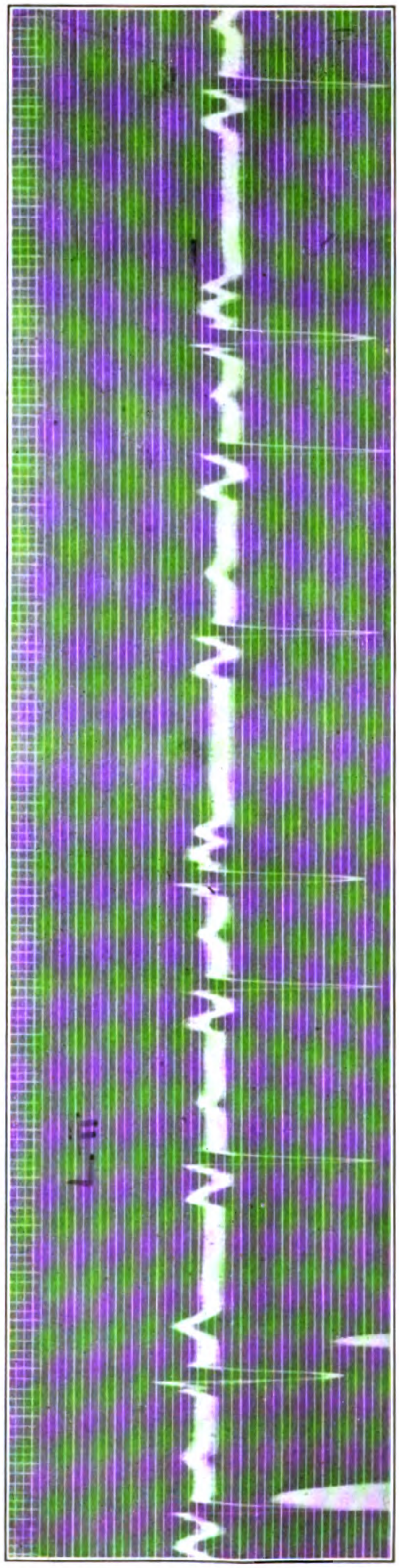

FIG. E.—A LONGER STRIP OF LEAD 2 OF FIGURE D

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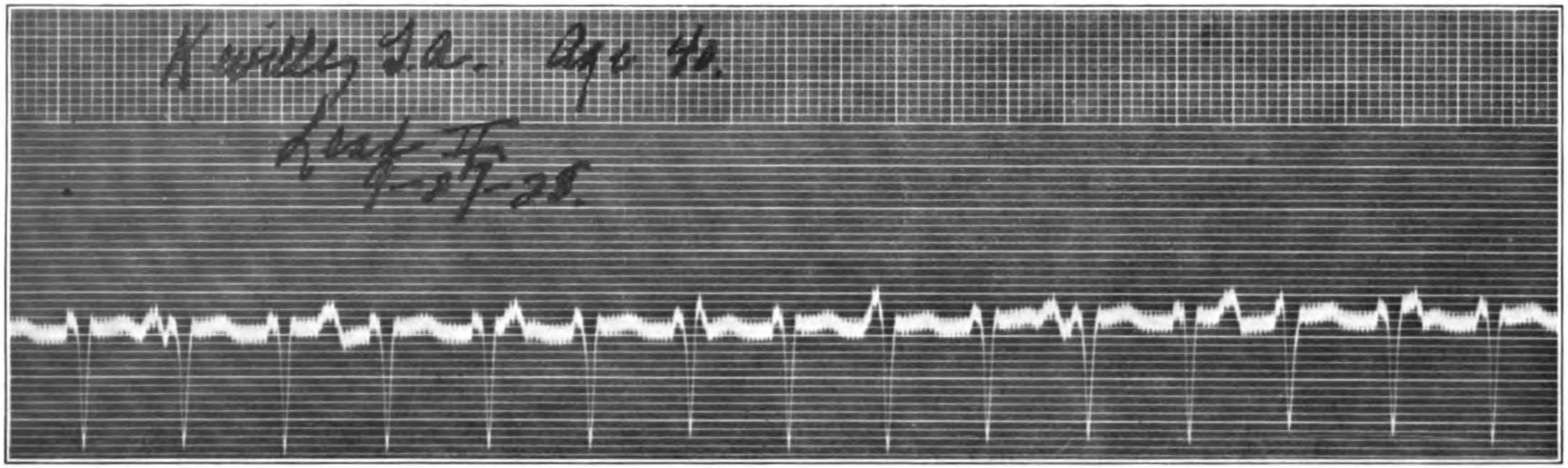

FIG. F.—TAKEN THE DAY FOLLOWING TRACING SHOWN IN FIGURE A. VENTRICULAR RATE ABOUT 166; AURICULAR RATE BETWEEN 92 AND 96. THE INTERVAL BETWEEN BEATS MEASURES QUITE CONSTANTLY 0.36 SECOND

934—4

For anyone sufficiently interested, Carman and Fineman, in July, 1924,[1] published a very able résumé of the matter, and Da Costa, in the latest edition of his textbook, gives a clear and concise picture of the condition. Up to 1924 there were approximately 1,200 cases upon record.

That the subject is of importance is shown by the fact that of the large number of cases reported up to 1921 only 44 were discovered during the life of the patient, according to Breitner, and the same author states that of 56 cases reported in 1921 and 1922 only 4 were diagnosed from purely clinical data.[2]

The transverse colon is most often strangulated and the condition usually follows a sudden strain or trauma which forces one or more of the viscera through the opening into the thorax.

The symptoms of diaphragmatic hernia with strangulation are severe, sudden pain localized in the epigastric region, violent vomiting, dyspnea, a boat-shaped abdomen, great thirst, constipation, and respiration of the superior costal type. Diaphragmatic hernia must be differentiated from pneumothorax, fluid in the thoracic cavity, elevation of the diaphragm, and diverticulum of the esophagus. The final diagnosis will be made or confirmed by the X ray.

## Case Report

W. A. H., sergeant, United States Marine Corps. Age, 40. White. Single. Admitted April 21, 1928. Diagnosis undetermined.

*Chief complaint.*—Pain in the epigastrium and vomiting.

*History of present illness.*—Patient admitted to this hospital complaining of pain in the stomach and vomiting. Stated that about one week ago (April 15) while firing from the prone position on the rifle range he suffered a sudden sharp pain in the left nipple region, which radiated to the umbilicus. The pain subsided three days after onset and reappeared on the 19th. He vomited a bile-green stained fluid the evening of the day following onset of pain. He has vomited almost constantly since the recurrence of the pain and this has relieved the pain. Vomiting was provoked by drinking or eating, and at each attempt to drink or eat the pain was increased. He was given sodium phosphate at the Army hospital without obtaining relief. Soda had no effect. Enemata aided in expulsion of gas which slightly relieved his discomfort. He had no fever but had a chill the evening of the 19th. Had no appetite. Believed that he had lost 10 or 15 pounds in the past 10 days. Bowels: Constipated. Stools: No history or evidence of bloody, clay colored, or tarry stools. No jaundice. Stomach was larger than normal and was ballooned up. Headache: Dull—temporal region. Slept very little because of pain in the abdomen. Eyes, ears, nose, and throat, negative. Chest: Respiration embarrassed because gas pushes up the diaphragm. No pain in the chest. Short winded. No swelling of ankles. Nicturia, once a night. Coughs a little, raises a small amount of phlegm; no blood. G. U.: No dysuria, pyuria, or hematuria. Extremities, negative.

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[1] Carman and Fineman: Diaphragmatic hernia. Radiology, *3;* 26, 1924.

[2] Breitner: Quoted in ref. (1).

*Past history.*—Patient had usual childhood diseases. Influenza in 1918. No venereal disease. He had an acute attack of what apparently was acute gastritis in August, 1927.

*Family history.*—Father dead; thrombosis. Mother living and well. One brother dead—tuberculosis (39 years). No history of diabetes or cancer.

*Physical examination.*—Adult male, showing dehydration effects of protracted vomiting. Head, negative. Eyes, ears, nose, and throat, negative. Chest movement restricted on left side. Right lung shows exaggerated breath sounds. Left lung, breath sounds absent. Percussion gives a tympanitic note from base to the level of the nipple. Abdomen: Markedly distended and tympanitic. Liver dullness obliterated. Hyperperistalsis on left side. Pulse, 110; respiration, 22; temperature, 98.6. White-blood cells, 10,800.

Patient's stomach was washed out, which relieved the distension. A diagnosis of intestinal obstruction due to strangulated diphragmatic hernia was made and an X-ray examination with and without barium enema requested. The accompanying plates show plainly the findings. (Figs. 1 and 2.) As the barium did not pass upward even under pressure, the diagnosis of strangulation was confirmed.

*Operation.*—As the signs of obstruction were paramount the abdominal route was selected. An upper left-rectus incision was made and the gut delivered. The peritoneal cavity was protected, the gut was opened, and a large amount of gas and fluid escaped. The gut was gently milked between the fingers until the distention had disappeared. Immediate improvement in color, pulse, and character of respiration was noticed. The hernial orifice in the diaphragm was explored from below and gentle traction was exerted upon the transverse colon. The patient immediately went into collapse. It was then decided to return him to bed, without attempting to open the thorax, and wait to see if he would react sufficiently to permit reducing the hernia by the thoracic route. This hope was not realized, and the patient died 8 hours after leaving the table.

*Autopsy.*—Two hours after death.

Body of man apparently 40 years of age; lividity marked. Rigor mortis not markedly present in upper extremities; beginning in lower extremities. Weight, approximately 160 pounds. Appearance of dehydration. Recent operation wound in abdomen. Scar on dorsum of penis. Abdominal fat, scanty. Fascia and muscles, thin. Free blood-stained fluid in the peritoneal cavity. Ascending and transverse colon distended. Small intestines normal. Chest: Mass in left chest (as shown in illustration). Heart is displaced to right. One thousand cubic centimeters of dark brown, fetid fluid present. Mass consisted of gangrenous omentum and a gangrenous loop of the transverse colon. The loop of the gut had taken a half twist upon itself. The lower lobe of the left lung was involved in the mass, and the pericarium was adherent to it and very friable. The hernial opening was in the left leaflet of the diaphragm and was about 2 centimeters in diameter. The edges were sharp and smooth. It did not look like a recent rupture.

In reviewing this case it will be noticed that the symptoms are nearly an exact reproduction of the textbook picture. The attack of gastritis in August, 1927, was in all likelihood a protrusion of the viscera through the hernial opening, at which time the omentum probably slipped through and, though the major portion was self

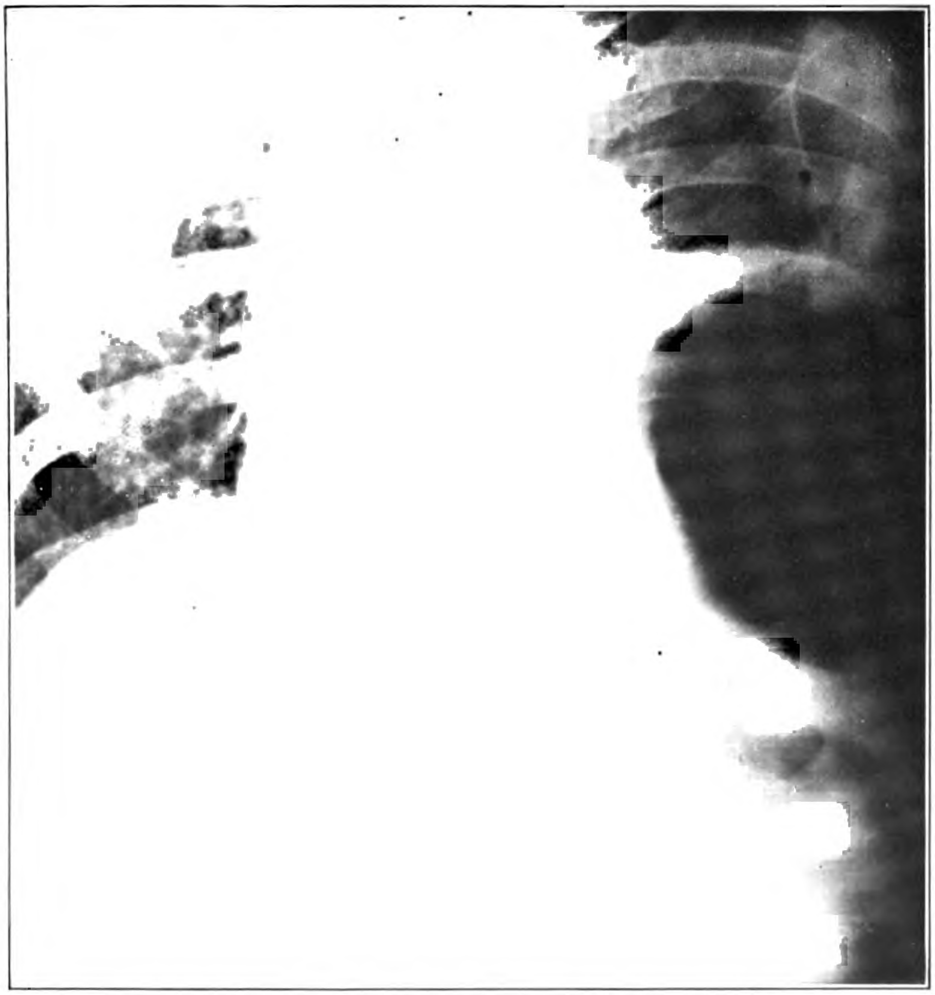

FIG. 1.—STRANGULATED DIAPHRAGMATIC HERNIA. (ELLIS)

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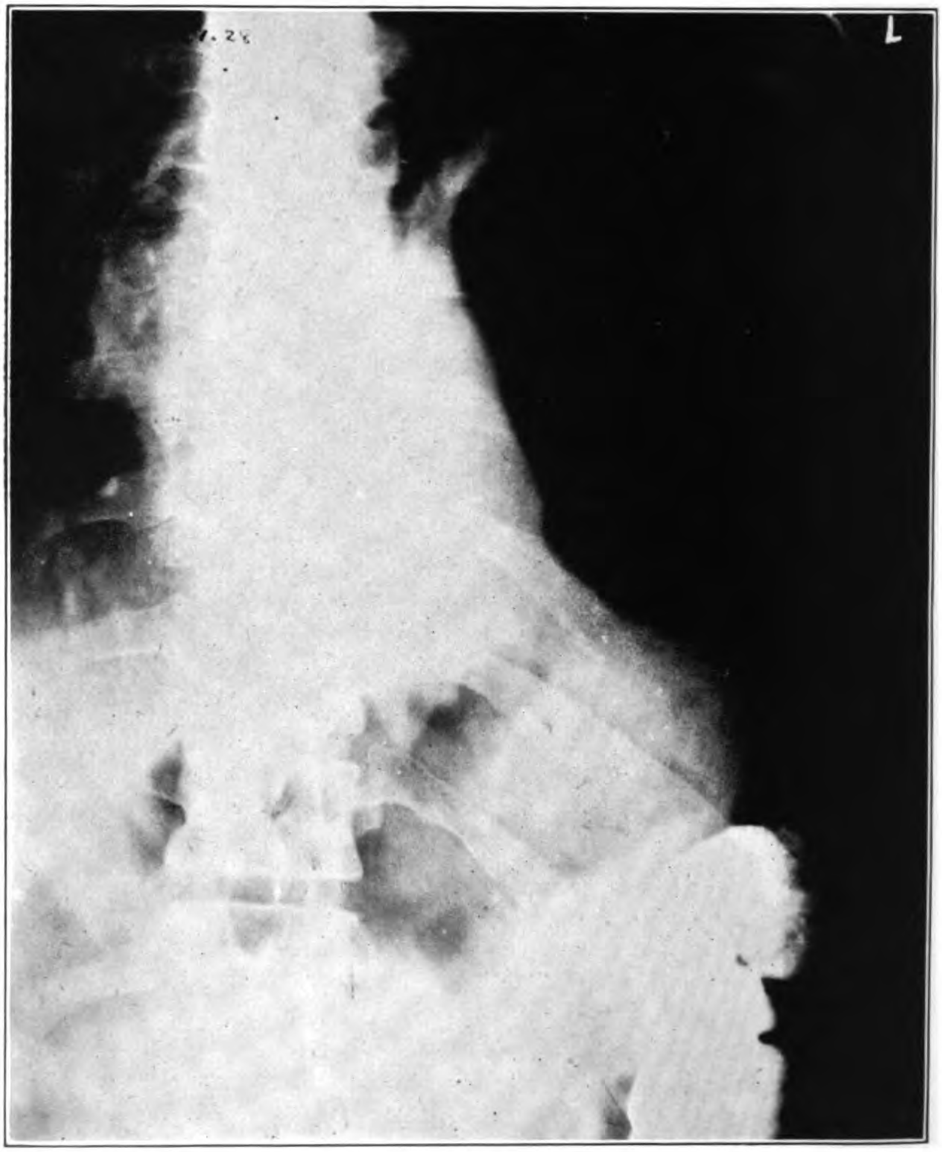


FIG. 2.—STRANGULATED DIAPHRAGMATIC HERNIA. (ELLIS)

926—2

reduced, some remained. The pressure upon the abdomen during the firing caused an upward thrust upon the transverse colon which followed the path of the omentum and, aided by the aspirating action of respiration, entered the thorax. The elapsed time between the onset of symptoms and admission to the hospital—one week—was long enough to establish sufficient pathological changes to make surgical procedure practically impossible. The drainage of the obstructed gut was of paramount importance; this done, the condition of the patient did not warrant further attempts to reduce and repair the hernia. Autopsy showed it was a hopeless task.

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## ACROMEGALIA

### Report of Case

By J. R. Thomas, Lieutenant Commander, Medical Corps, United States Navy

Acromegalia, also known as Marie's disease, is now generally recognized as being due to an increase of the function of the glandular hypophysis and is characterized by gradual enlargement of the hands, feet, head, and thorax, and by a dorsocervical kyphosis. There is an overactivity of the vegetative nervous system, causing a metabolic unbalance and resulting in hyperplasia of the endocrine structures, especially of the thyroid, interstitial gonadal cells, and of the suprarenal cortex. It is not a very rare disease and it affects the two sexes nearly equally. It usually begins between the ages of 20 and 40 years, although cases have been reported beginning in early childhood. No hereditary influence or definite exciting cause is known.

Pathologically, in practically all of the typical cases of acromegalia, there is found an enlargement of the pituitary body, with an adenoma, or adenocarcinoma, of the anterior lobe. As a rule, the whole pituitary gland finally becomes involved. There is a hyperplastic alternation in the entire osseous system. As the pituitary body enlarges it causes distention of the sella turcica and, in the late stages, pressure on the surrounding structures. The skin and subcutaneous tissues are thickened. X-ray picture of the skull usually shows a widening of the sella turcica and may show destruction of the clinoid process.

Symptomatically, the disease begins with a gradual enlargement of the bones and soft parts of the hands, feet, and head, including the nose, lips, and jaws. The nose becomes monstrously thickened, the lips large and everted, the jaw massive and protruding. The mucous membrane of the oral cavity becomes thickened and the tongue greatly enlarged. There is frequently a spreading apart of the teeth on account of the enlargement of the lower jaw. The

wrists and hands become markedly broadened and the fingers thick and stumpy, the feet being likewise affected. There is a characteristic dorso-cervical kyphosis and the chest is enlarged antero-posteriorly. There is usually amenorrhea in the female and loss of potency in the male. The skin is thick and dry and appears to be edematous, but does not pit on digital pressure. There is frequently a polyuria. There may be vasomotor and cardiac disturbances. Disorders of metabolism occur with glycosuria. Headaches, general malaise, general weakness are present. There is a striking contrast between the size of the patient and his general strength. Due to pressure of the growing tumor in the pituitary body frontal headaches result. The vision becomes impaired because of the pressure of the enlarged pituitary body on the optic chiasm, which causes bitemporal hemianopia and optic atrophy. Ocular palsies may occur. The mental changes vary from sluggishness to deterioration.

Prognosis is grave. Duration from 5 to 20 years.

### Case Report

E. B. K. (V. B. P.); age 31 years; admitted to the hospital June 10, 1927, as with acromegalia and hemorrhoids.

*Complaint.*—Headaches, general weakness, painful swelling about anus, and bleeding from rectum following defecation.

*Family history.*—There was no history of tuberculosis, cancer, or any other familial disease.

*Past personal history.*—Patient had the usual childhood diseases with good recovery. In general, his health had been good until 1919, when he developed hemorrhoids. He noticed about this time that he was becoming heavier, his bones growing thicker, weight increasing rapidly, and that there was a feeling of laziness coming over him. Later, about 1925, he noticed that his field of vision in left eye was becoming contracted and he began having frequent attacks of frontal headaches. On June 4, 1925, he was given permanent total disability for acromegalia and optic atrophy. Patient denies venereal history and the use of drugs, tobacco, and alcohol. Has had no serious injuries. Was operated upon during 1925 for bleeding hemorrhoids and received temporary relief, but the hemorrhoids have recurred, causing greater discomfort than before. Patient is single and is a manual laborer by occupation.

*Physical examination.*—White male, age 31 years, apparently of stated age. Patient is very broad and thick in stature, weighs 225 pounds, and is 70 inches in height. The head projects forward due to kyphosis of the upper dorsal spine. The abdomen is large and pendulous and there is some lordosis of the lumbar region. The hair distribution is normal, the skin is thick and appears to be edematous, but does not pit on digital pressure. The wrists and hands are very broad and thick, as are the feet and ankles. All the bony prominences on face are markedly increased, presenting a typical picture of acromegalia. The eyes show a divergent strabismus; the pupils react to light and in accommodation. The field of vision in the left eye is markedly contracted due to partial optic atrophy. The ears, nose, and throat are negative. The tongue appears to be larger than normal. The lower teeth are spread apart. The neck is short and thick and the thyroid gland appears to be normal in size. There is no

FIG. 1.—X RAY OF SKULL. ACROMEGALY

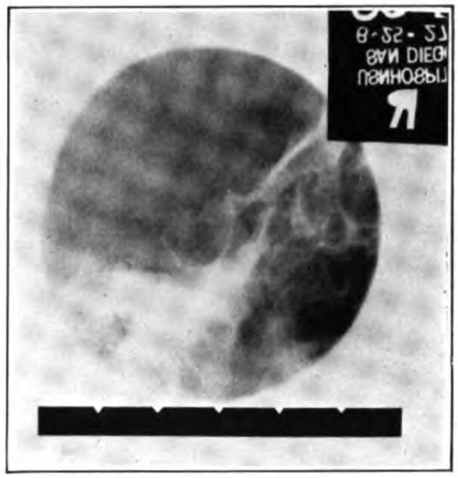

FIG. 2.—X RAY OF SELLA TURCICA IN ACROMEGALY. 6-INCH RULE BELOW

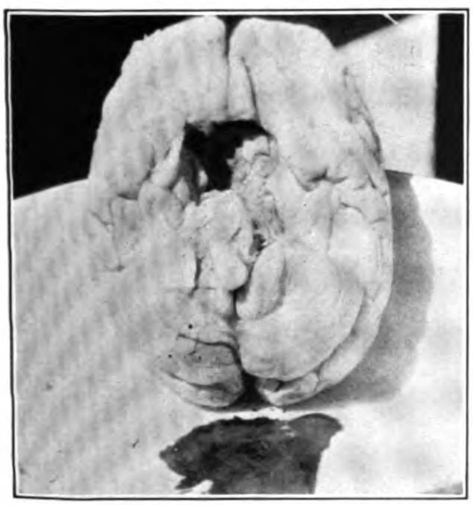

FIG. 3.—BASE OF BRAIN IN CASE OF ACROMEGALY

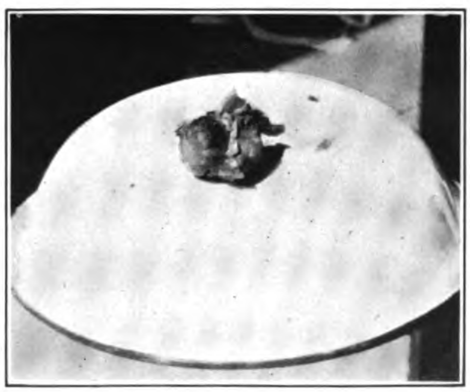

FIG. 4.—ADENOMA OF PITUITARY. ACROMEGALY

adenopathy present. The heart and lungs are negative, the chest is very wide and deep. Blood pressure: Systolic, 124 mm.; diastolic, 64 mm. The abdomen is large, lax, and pendulous, otherwise negative. The pelvis is wide and deep. The genitalia appear to be normal. The rectum shows three large masses of internal hemorrhoids. The reflexes are sluggish. Temperature, 98.4°; pulse, 80; respiration, 18. Blood Kahn test, negative. Urine: Total for 24 hours, 2050 c. c.; otherwise negative. Basal metabolic rate, taken June 25, 1927, plus 10 per cent. Electrocardiogram, June 25, 1927: "Lead–1: Rate, 74. Moderate sinus arrhythmia. R–19 and S–14 mm. T wave, diphasic. P wave, broad and notched. Lead–2: P–R interval, 0.22 of a second. Q–S, normal. R wave, slurred on ascending limb near base. T wave, isoelectric. P, broad. Lead–3: R–11 and S–3 mm. Q–R–S, vibratory. T, diphasic. P, inverted. Impression: Moderate sinus arrhythmia. Prolonged conduction. Poor nutritional tone of the ventricular muscle. This E. C. would indicate a marked lowering of the cardiac tone, with no definite pathology."

Blood sugar, June 27, 1927, 118 mgm. per 100 c. c. of blood.

Patient was operated upon under local anaesthesia June 13, 1927, and three masses of internal hemorrhoids removed, no complications resulting.

Convalescence was uneventful, and on June 27 a series of X-ray pictures was taken. On the following day patient was seized with violent attacks of vomiting, projectile in type, associated with intense headaches. Temperature, 97.4°. On June 29 his condition became worse, the temperature rose to 103°, the pulse varied from 40 to 56, the respiration remained at 20, vomiting and headaches continued. On June 30 the temperature suddenly rose to 106° and the patient became delirious—pulse, 110; respiration, 27. The bases of the lungs revealed beginning pneumonia. Patient showed no response to treatment, dying at 3.25 a. m., July 1, 1927.

*Autopsy findings: Head.*—The pituitary is greatly enlarged and presents as an encapsulated, ovoid tumor 4 by 7 centimeters, dark red in color. It is quite friable and is torn during removal. The optic chiasm is compressed and the sella turcica shows marked excavation, the posterior clinoid processes being destroyed.

*Thorax.*—Both lungs show hypostatic pneumonia.

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1. Nelson: Loose-Leaf Medicine.
2. Osler: Principles and Practice of Medicine.
3. Falta and Meyers: Endocrine Diseases.
4. Jelliffe and White: Diseases of Nervous System.

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# LEPROSY

By I. S. K. Reeves, Captain, Medical Corps, United States Navy

It is the duty of the members of the Army and Naval Medical Corps as well as Public Health officers to be prepared to recognize the leper when encountered in routine work.

The diagnosis of this disease requires more than an academic knowledge. While only a few of us may have the opportunity of seeing and observing over a long period of time numerous cases,

there are many service men who can review the cases in the leper homes in various ports of the world.

How many naval medical officers visit ports where there are leper homes and never see a case, in spite of the fact they would always be welcome and by their interest do something for these unfortunate people?

It is time that leprosy be given the care and attention we give to the victims of other diseases. First, we should train our medical officers to diagnose the disease. Leper homes are frequently admitting cases far advanced which have been seen and not recognized by able men in the medical profession.

When we admit patients to our hospitals or examine them in private practice rarely does the question of leprosy enter our minds, yet at Carville, La., there are 255 patients collected from all parts of the United States.

In the leper homes cases are so different in their manifestations that we are impressed with the saying that "There are at least 57 varities." This expression, coming from a man of such experience as Dr. J. T. Wayson, of Honolulu, should give us cause for study. The early stages of a macular eruption on the extremities or head, or early vasomotor changes, might be easily overlooked or thought to be an urticaria following the consumption of shellfish. A snipping from the edge of the lesion, stained with carbolfuchsin, would demonstrate the lepra bacillus.

This "snipping" of the skin is performed by blanching the part by pressure for a few seconds between the thumb and forefinger. Then the point of a razor blade is used to incise the skin, not deep enough to draw blood. By turning the blade with a scraping movement a bit of tissue without blood will be obtained on the razor edge. Place this on a slide and stain as for tubercle bacillus. In positive cases the lepra bacillus will be demonstrated.

A snipping from the nose is best taken with a blunt dissector, removing part of the mucous membrane for examination.

Hyperextension of the phalanges on the metacarpals, with atrophy of the thenar and hypothenar eminences, are signs that a neuroleper can not conceal, and snipping of the ear may demonstrate the bacillus. Surg. N. E. Wayson, of the Public Health Service, in charge of the Leper Investigation Station in Honolulu, continually emphasizes the fact that vasomotor disturbances are the most characteristic signs of the disease. We should bear in mind that the nerve cases show the ulnar, posterior auricular, or the peroneal nerves most often affected, with accompanying characteristic muscle changes. The bacillus can be most readily demonstrated in these cases by snips from the ears or from the nasal septum.

It is not desired to discuss here the numerous lesions of leprosy, but it is hoped this article may stimulate an interest in the disease and encourage further study of its manifestations when opportunities afford.

There were several cases of the disease found among the enlisted personnel of the Navy and Marine Corps during the World War and that alone should emphasize the importance of its recognition by medical officers. Cases were admitted to the Leper Home at Carville, La., last year from 15 States. This should awaken the interest of medical societies and civilian practitioners.

While we are prone to think of leprosy as a chronic disease, we see many cases in our leper homes which are acute and might readily be mistaken for other conditions. The acute forms have recently been given considerable attention and papers written on the subject. While the disease may lie dormant for years it is apt to show acute exacerbations at the time of puberty. Women have acute symptoms at the time of menstruation, and pregnancy will activate an organism which has been attenuated for years.

Specific treatment is still unsatisfactory. Institutional hygiene, physiotherapy, diathermy, etc., are being used with some results, and a large percentage of cases show improvement with the use of Chaulmoogra oil. Eventually the wide field of science will surely develop something more specific.

The diagnosis of leprosy will be made more easily if we bear in mind that there are many varieties of each of the types—neuro, nodular, and macular—and examination by snipping of the skin is imperative.

The most important factors in leper control appear to be the recognition of the disease in its early stages; more liberal methods of segregation, founded on the same principles as pertain to the isolation of tuberculous patients; then intensive institutional treatment, with occupational therapy and intelligent observation of patients for years after their discharge from the leper homes, when the disease appears to be arrested. This can be encouraged by paying the leper to appear for examination by the public-health authorities.

When one learns that the Leper Home at Carville, La., admitted 56 patients last year and that 40 of them ran away, it becomes evident that there must be more than a local condition of affairs with which to deal. One does not hear of tuberculous patients absconding from a sanitarium, where they are treated with kindness and consideration, as their morale is not ruined before they are admitted. They are glad to avail themselves of the institutional treatment. When the leper receives the same consideration and treatment he will no longer hide away from civilization and run away from treatment.

Of all the suffering in the world to-day, that of the lepers is most sad. They usually bear up with a smile even under most unfavorable conditions. Much more can be done for them. Except for a few devoted friends who struggle alone in their cause, they are sadly neglected. Every well-informed doctor, through his knowledge and interest, can be the beacon to lighten their pathway and can help to stamp out this much-dreaded disease.

# NAVAL RESERVE

## NEW APPOINTMENTS

| Name | Rank and class | Date appointed |
|---|---|---|
| Adams, John Quincy | Lieutenant (junior grade), M. C.-V (G) | May 11, 1928 |
| Donahue, Claude Mathew | do | May 28, 1928 |
| Fonde, George Heustis | do | Apr. 17, 1928 |
| Jelstrup, Gunnar | do | Mar. 15, 1928 |
| Lionberger, David Leo | do | July 12, 1928 |
| McGill, Paul Rockhold | do | Mar. 19, 1928 |
| Naeckel, Harold William | do | Apr. 14, 1928 |
| Northington, Page Oscar | Lieutenant commander, M. C.-V (G) | Apr. 28, 1928 |
| Owings, Capers Baxter | Lieutenant, M. C.-V (S) | May 18, 1928 |

## TRANSFERS

| | | |
|---|---|---|
| Dalton, William Aloysius | Lieutenant commander, M. C.-V (S) | June 5, 1928 |
| Wildman, Arthur | do | Apr. 27, 1928 |

## PROMOTED

| | | |
|---|---|---|
| Herndon, Raymond F | Lieutenant commander, M. C.-V (G) | June 28, 1928 |

## NURSE CORPS

### MEDICAL SOCIAL WORK AND ITS APPLICATION TO ARMY AND NAVY HOSPITALS

By FRANCES MCCLAUGHRY, Field Director, American Red Cross, Naval Hospital, Puget Sound, Wash.

Civilization as constituted to-day is a vast process of interwoven human activity functioning under established but shifting methods and standards. Our social institutions are founded on the premise that all are endowed with the same potential ability of adaptation, but with the progressing complexity of our civilization more clearly have we grown to recognize the fallacy of this assumption. The increasing breaking down of mankind under the weight of our amazing progress illustrates that all individuals do not come into the world equipped to adjust and cope with civilization as it now exists. The fact of their entry into a man-made world, and not a biologic one, means an adjustment. Our instinctive reactions differ little, if any, from those of the early ages, when man ruled wholly at the instinctive level—rather does the difference lie in modern man's ability to indulge in that socializing mechanism of sublimation which developed during the transition period from merely a hind brain to the acquisition of a fore brain, and which tied up our emotional drives with our intellect. Out of this competitive march of civilization, with its accompanying human wastage, has grown the need for social work.

Social work is the science of adjusting personal relationships—the relation of man to man and of man to society. It is the constructive force among the pathological conditions of society, the cumulative effort of society to "take up the slack"; to make the best adjustments possible in situations where the individual does not meet the requirements of society or society fulfill its duty to the individual. It is inclusive of all that is done by society for the benefit of those who are not in a position to compete on equal terms with their fellows. Even as the physician must needs understand anatomy and physiology, so must the social worker understand the organization and processes which have evolved in society. Her relationship to social organization correlates the doctor's relationship to the body—as the physician endeavors to affect bodily health through his technique of

medicine and surgery, so does the social worker, through her technique of adjustment and adaptation, endeavor to affect human welfare.

There has always existed a supervising group. History gives us the endeavors of early kings and parliaments to handle the misfits of society. Ecclesiastical and public poor relief had existed long before the nineteenth century, while the English "poor law" found its origin in the breaking up of the feudal system. Until that time the greater group of society had lived as tenants on the estates throughout the land, and when in need or in difficulty, their social and medical problems were adjusted under the supervision of the head of the estate, to whom they looked for this guidance. The breaking up of the feudal system increased the mobility of society and set many individuals adrift. Here in a world, relatively simple, we find a group unable to cope with this new and strange order of things, and society not yet socially conscious of its responsibilities toward this group. Economic changes have always resulted in social disorganization, and our ever-increasing volume of social problems, which has reached the alarming proportions of to-day, finds its etiology in the ever-increasing complexity of our social machine.

Social work received its first great impetus at the beginning of the nineteenth century, when the humanitarianism and philanthropy of that time were merely responses to the needs which followed in the wake of the industrial revolution.

In the early part of the nineteenth century society existed almost wholly in the open country and in small villages—only 17 per cent of the population lived in places of 20,000 or over. By the close of the nineteenth century this had increased to 60 per cent and was the direct result of the transition of industry from the domestic system, whereby manufacturing was carried on in the homes of the workmen or in small shops, to the development which followed the remarkable series of inventions which took place in the cotton and woolen industries, and was paralleled by a similar age of invention in the metal trades. With the evolution of heavy and complicated machinery, such as the locomotive, steam engine, power loom, and cotton gin, we find industry entering the phase of large-scale manufacture, and with it the development of factories.

Where, formerly, every workman had a variety of duties—creative in themselves—there now developed a monotony of labor. Each man became only a single step in the process; a shifting from one factory to another began; names were supplemented by numbers, and the workman became thoroughly dependent upon the employer for his livelihood.

With this transition of labor and depersonalizing of industry began our economic unrest. This new phase of labor brought in its train new problems pressing for solution; insanitary factories, crowded houses, low wages, long hours, employment of women and young children, periods of industrial depression, and along with them a breakdown of customs, habits, and morals—a general social disorganization.

Here began the tasks of social work much as we find them to-day. Formerly families had lived as a unit—lived, worked, and played together—now the absence of the father or mother in the home destroyed the unity of the family life. Community life suffered disorganization. Where, formerly, communities had grown up for centuries together, society now became more and more mobile; workers moved about from place to place. Under simpler conditions there had been a single moral code—now a more complex group of people developed a new and more complex standard of ethics to which they must adjust themselves.

Health problems developed tenfold—poorly constructed factories with inadequate provision for light and air, heat, moisture, and dust-laden atmosphere, occasioned a vast amount of sickness. The " speeding up " of labor developed an early breaking down of mind and spirit; and so the social worker of the nineteenth century found herself faced with medical needs, the protection of health through sanitation, employment needs, provision for disability and old age, protection of children, education, and recreation. Society had broken loose from its age-old mooring—a new basis for social organization must be found.

The development of social work parallels the early history of professional education in other fields. It has never been a static thing but a thing of development and change based on the needs of civilization, following always the elemental steps, in the process of every modern science, beginning with investigation and proceeding to analysis and conclusion, applying them to a concrete situation, and, later, testing the results.

In the field of medicine it is only within the last century that we find the transition from the apprentice system to that of academic training. Formerly medical students would go about with the older physicians observing treatment and aiding in the dispensing of medicine. Out of this grew medical schools conducted generally on a commercial basis, while this was followed by the development, as we have it to-day, of medical schools in connection with the universities. In this last development most of the private medical schools either affiliated with the universities or went out of existence.

And so it has been with social work. For years the care of the needy devolved upon the church and was performed for the most

part by those who had no specific training, and was more often the outlet of the community urge for service.

The year 1898 marks the first appearance of systematic training, at which time a six-weeks' course was arranged by the New York Charity Organization. In 1904 a full course was instituted with the scope of the work extended, and marked the beginning of the New York School of Social Work. Harvard University and Simmons College followed next. For years the social worker had received her training on the job, but with the establishment of schools of social work the apprentice system has declined and there are now 24 schools of professional social work, most of them in connection with our largest universities and colleges. Nearly all are postgraduate courses which base their professional training on the social sciences, such as biology, economics, government and political economy, psychology and sociology. The medical social worker in addition to her training in the social sciences must have training in medicine, while the psychiatric social worker must have both medicine and psychiatry. Only with this knowledge in hand can she appreciate the social significance of a diagnosis. In general, all courses include training in family case work, neighborhood and community work, social research, medical, and psychiatric work. While practically all have utilized the plan of specified periods of supervised field work, there has been no line of demarcation between what might be considered clinic observation on the one hand and practice on the other.

The old order has disappeared and with it the Lady Bountiful. The motive has changed from one of philanthropy to one of public service; from an interesting diversion to a profession. The work has emerged as a specialized one equipped to correlate the interrelated processes in all fields of social welfare. Because of this interrelation one process is apt to involve any other process in the field before its completion. Often the hospital case requires economic social work; the economic failure may be the end result of a medical problem, or the family case worker may find her difficulties revolving about a psychopathic figure which has become the dynamic force in the household. It is this relationship of social processes that gives to us the essential unity of all social work.

Medical social service is a "development of modern medicine which has grown up to meet the need occasioned from the change of the faimily doctor to group medicine." Its development came directly from the medical profession, and was stimulated by Dr. Charles Emerson and later by Dr. Richard Cabot, of Boston. In 1902 Doctor Emerson organized a group of medical students from Johns Hopkins for social training. Recognizing that effective medical training must

include an understanding of the background of the patient's life, and some knowledge of their standards of living, he organized the first student board of the Charity Organization Society in Baltimore. One or two families were assigned to each student, and over a period of from weeks to even four years the student studied the relation between the man and his environment. It is from Spencer that we receive our concept of "life as a continuous adjustment of inner to outer relations." Sociologists began with the outermost of life's relations—namely, group relations of family to the community; psychologists deal with man's inner relations as they touch society, but the social worker must needs stand in the center of these adjustments as they touch man to man.

In 1905 Doctor Cabot introduced the social worker into the hospital. In her he found a means for more accurate diagnosis and effective treatment, and since 1905 there have developed over 400 social-service departments in connection with our civilian hospitals and dispensaries, functioning always as an integral part of the institution.

Doctor Cabot has stated that "in order to make the doctor's work worth while to himself and the patient it must be done in cooperation with some one who has time and ability to appreciate the needs of the patient and to supervise the recommendations as laid down by the doctor, to follow up on the treatment so necessary with the departure of the patient from the hospital, to study home conditions and report on their part in causing or prolonging conditions, to help modify these conditions—financial, mental, or moral—which stand between the patient and recovery. This some one is the social worker."

In 1918 medical social work was introduced into the military service. Men were pouring into our Army and Navy hospitals from all sections of the country, and the service groups were faced with an immense task. The need for trained workers was immediate and great, but they were few in number, and even yet this number is relatively small. The Red Cross, with its network of over 3,500 chapters throughout the country, was peculiarly adapted to the assumption of this work, and the medical social program has now become a primary function of Red Cross. It began as a war measure, and since then the need has grown so obvious that at this time trained medical social workers are functioning in practically every Army and Navy hospital. Because of the rigidity of the military environment and the mass of legislation governing service men, social work in this field has become a specialized one.

The work in the hospital falls into three divisions, each contingent upon the other: First, the social investigation; secondly, the hospital adjustment with its accompanying plan for rehabilitation where

necessary; and, thirdly, the institution of follow-up work at the time of the patient's departure from the hospital.

Considering first the social investigation: As an aid to diagnosis and to a more intelligent handling of the case, this can not be minimized. At one time we studied our patient from a cross section of his life, but have since come to recognize the need of a longitudinal section in order that we may properly interpret the clinical picture. It is often back in the community from which the man comes that we find the setting for his present reactions, which, step by step, have been developing. Our men are coming into our hospitals from all parts of the country, and their reasons for enlistment are many and varied. These reasons often color the patient's military career, and at times are the basis for absence without leave, desertion, or other types of conduct which prevent the patient from adjusting to the military routine. Often the military environment is the direct antithesis to any environment he should be in. If the doctor has in his hands a history of early truancy, shifting occupational career, prolonged conflict with civil authorities, and an early military hospitalization for which he can find no reason, he is able to make an early diagnosis in many instances of unfitness for service. We recognize the military existence as being one which adapts itself in no sense to the individual; rather must the individual adjust to it. With a history of prolonged inability to adjust to a less rigid environment the doctor clearly recognizes the futility of endeavoring to adjust a patient to this, a more rigid one. First enlistments come to us with no past medical record. Not only for diagnostic purposes but for the good of the service as well as the man it is important to have data relative to an early health history. Often obscure conditions in a remissive state are brought to light. This is particularly applicable to mental conditions, as illustrated in the following instances.

*Case A.*—Patient was admitted to Letterman hospital from the Philippine Department, at which place he had been under observation because of his inadequate adaptation to the military environment. His record was one of continuous service since 1917. His Army record showed no serious military offenses, but was one of inadequacy. He had been returned to the States with a view of elimination under that section covering morons, psychopaths, and that group within the service who are unable to fit into military routine.

The picture presented was one of an inadequate psychopath with a marked paranoid trend, which trend seemed to have developed on a basis of his own inability to adjust to military life. No evidences of a psychosis were manifested. It was felt that he had successfully soldiered during the war period because of the high emotional tone which, in many instances, carried these inadequate types through. The routine and monotony of postwar service appeared to be one to which he could not adapt, and it was considered best for the good of the service and the man that he be discharged on a nonmedical discharge and returned to civil life. On reaching Letterman he was admitted to the open N. P. depart-

ment, where his condition remained stationary for at least a month, during which time a social investigation was made in the man's community. The social history brought out that in 1912 patient had, in response to definite paranoid delusions, killed his employer. He had been adjudged insane and committed to a State hospital in Texas. After a five-year period of hospitalization, and what appeared to be a social recovery, he was paroled to the community and had immediately enlisted in the Army. In view of this history of a specific psychosis, patient was transferred to the closed N. P. department where, within two weeks, a recurrent psychotic episode was manifested. His inadequate reactions had been not those of psychopathic inferiority, as had originally appeared, but were the residual of his former mental breakdown. The mild paranoid trend was an early manifestation of the recurrence of the underlying psychosis. He developed marked paranoid delusions and the entire clinical picture now changed to one closely resembling a true paranoia, which type mental case is the most dangerous to be at large because, unlike the paranoid præcox, they generally react to their delusions. From Letterman he was recommitted to the State hospital. Had it not been for the social history which showed a former mental breakdown followed by a remissive state, this man would have been discharged into the community prior to the development of the recurrent attack. In a sense, the Army or Navy hospital is utilized as a clearing house for diagnosis and disposition rather than one of permanent hospitalization. Often the clinical picture does not demonstrate clearly a need for prolonged hospitalization and the military machine is set in motion for the man's discharge into the community. It is the social history that often gives the basis for prolonged hospitalization. The social investigation in this instance changed the entire handling of the case, and protected both the patient and the community.

*Case B.*—Patient was admitted to Letterman Hospital with a diagnosis of "Moron, low grade," the diagnosis being based on patient's reactions in his detachment. He had been unable to carry out the simplest commands, could not learn his orders, and had no appreciation of responsibility when placed on guard. Patient had been under observation in Hawaiian Department for possibly a month prior to his admission to Letterman. He had been before the discharge board and returned to the States for nonmedical discharge for the good of the service. A transfer diagnosis is never a final one, and patient was referred to the social service department for a psychological rating. The phychological test classified the man as a high-grade imbecile; but because of a marked scattering and an occasional blocking, the results of the test were not considered sufficient to make a diagnosis of imbecility, and a social investigation was instituted. The report from the man's community brought out that he was a high-school graduate and had completed one year in college. He had left college suddenly, and worked for a time in an attorney's office, but after an employment period of three months had disappeared, and the request for investigation was the first contact his family had had since that time. The social history clearly established the fact that the present reaction was not one of low inherent mentality, but of an obscure mental condition which was unquestionably the cause for the cutting short of the college career and the subsequent disappearance from his community. The onset of the psychosis was gradual, no hallucinations or delusions were elicited, no introversion present. Other than facts illustrated by the social history, there was no reason to suspect an underlying psychosis. Patient was detained at Letterman, developed a mild hebephrenic excitement, from which he shortly made a social recovery, following which he was returned to his community under the care of the local

Red Cross chapter, which is at this time acting as supervising agent in the community. Had the diagnosis of imbecility remained, patient would have been transferred to an institution for feeble-minded, as being unable to care for himself. In this instance both the doctor and patient were saved from the embarrassment which would have attended a diagnosis of this kind. The patient is now being helped to adjust without the stigma which would have resulted from an institutional residence.

The second field of work—that of working with the patient in the hospital—has numerous phases. The primary function is in aiding in the adjustment to the hospital routine, and obtaining the patient's cooperation for a successful working out of the medical plan for treatment, and later the social plan. In many instances, because of the patient's lowered tension, we find his interests centered almost entirely in his own illness. Because of his physical condition, his perspective is lost, or is limited, and he fails to appreciate that the busy doctor can not give him his entire attention. He feels neglected and becomes dissatisfied with the hospital routine. This dissatisfaction may develop a depression which retards his recovery, or a pugnacious attitude which brings him in conflict with his fellow patients.

*Case C.*—Patient was admitted to this hospital from the Veterans' Bureau suffering from an otitis media. Contact was made following observation at Red Cross House, where seclusiveness and inability to fit in with the rest of the hospital group were noted. He alternated between periods of moodiness and those during which he wished to fight everyone. In card games or at the pool table he was generally an onlooker, seeming to express a real need for companionship but unable to find a common ground on which to meet the other men. The social history disclosed a criminal career dating from his postadolescent years, and a subsequent shifting occupational history. This had been preceded by a history of truancy which appeared to have as its basis the ear condition which had resulted from an attack of scarlet fever during childhood. Because of his inability to hear, he had been unable to keep up with his class, and an apparent neglect of lessons resulted in continual punishment, patient finally resorting to truancy as an escape from his difficulties. Constant apprehension by the truant officer earned for him a reputation of incorrigibility. Normally a sensitive personality, he concealed his physical handicap and no contact seems to have been made which would have aided him in establishing himself. Committment to a reformatory followed, and subsequent to the unsupervised period following parole, a shifting occupational career began. Unable to maintain employment, two prison sentences and one jail sentence followed, the first for theft of food and clothing. He enlisted during the World War, had no difficulty, and received an honorable discharge. His physical condition has grown progressively worse. The noises in his head distress him and at times he feels he is developing an abnormal mental state. Has developed almost a phobia regarding his approaching operation, feeling sure that he will die under the anesthetic. His emotional instability brings him into conflict on his ward regarding his detail and under the impulse of these conflicts he prepares to leave the hospital, although his treatment is not yet completed and his condition only slightly improved. At present, both mental and physical condition is such that were

he to attempt to return to civil life unsupervised he would in all probability shortly be in jail. His personality make-up is such that supervision is necessary to enable him to remain in the community.

Request was made that he be assigned to the Red Cross house detail. He has responded to supervision, has assumed responsibility and attends to his work in a more efficient manner than any detail we have had in the past two months, exercises considerable initiative and is always pleasant and cooperative; has been given free access to all storerooms containing supplies and, although his entire criminal record is one of thievery, no evidences of these tendencies have been manifested. His emotional outbursts are less noticeable, and with the increasing feeling of being necessary he is finding his place in our hospital community.

His operation will shortly take place, and at the time of his discharge an effort will be made to find employment in a supervised environment. It is recognized that no constructive work can be done at this late day; he can not be made an asset in the community, but at least we can endeavor to adjust him to an environment in which he will not become a liability.

Surgical cases permanently handicapped can be started on vocational courses under State rehabilitation. While in the protected environment of the hospital, the cripple in this way can be given something to hold to at the time of his return to his community.

In other cases the social service department acts as the liaison between the home and the man, and is in a strategic position to adjust financial or medical difficulties in the home, which harass the patient and which often result in desertions or an absence without leave. Very often families contact the man relative to medical or economic problems which have arisen in the home and he is faced with the responsibility of endeavoring to make a decision for the family. He is torn between his duty to his family and his organization. With the local Red Cross called in by the hospital worker to handle the difficulty, generally the situation can be satisfactorily adjusted and a possible desertion prevented.

Recreation both active and passive is another phase in the hospital adjustment, and is instituted always with the view to providing an outlet for the play instinct, and in building up and maintaining the morale of the patient.

Claims work is maintained and pensions are filed for all patients medically surveyed. Instructions as to procedure are given, or in many instances the man is referred to his local Red Cross in order that any difficulties which may arise in connection with his claim may be handled by someone familiar with the pension procedure.

The third division of the work is that of follow-up. Without this continuity of treatment, both medical and social, often months of medical care are lost. Diabetics, cardiacs, T. B's, surgical and mental cases, are the outstanding group for whom this work is so necessary. Away from the supervised routine of the hospital, the patient is apt to drift away from diet or rest as prescribed by the physician.

An orthopedic case may not be economically situated to equip himself with necessary braces—or be starving himself to provide them; cardiacs and T. B's recommended for light work become discouraged in their search for employment. This finding of so-called light work is one of the gravest problems facing the social worker. The demand far exceeds the supply. Often the physically handicapped individual is refused at the start. Labor has no room for those not able to compete on equal terms. Again work is given up because it offers lower wages than those earned before the illness. Economic plans are worked out for those requiring continual rest. Red Cross, T. B., and Public Health nurses are called in to supervise and to report back to the hospital in order that the doctor and worker may realize the progress of the patient. With this supervision recurrent conditions are often prevented.

*Case D.*—In the case of "D," patient was admitted to hospital suffering from a psychosis manifested by a mild introversion, slight affect, and volitional deterioration and occasional hallucinatory experiences, accompanied by a slight persecutory trend. The social history was extremely interesting from the standpoint of mechanistic psychology. Family history negative for specific conditions, although it seemed significant that numerous members of the family were subject to malignant diseases which might possibly have endowed our patient with a defective constitution. The family had no understanding of the personality make-up of the patient. School record was normal, patient's difficulties beginning during adolescence, at which time the father died and the entire responsibility of the managing of a farm of several hundred acres was placed on the patient, who had at all times reacted considerably to the farm environment and felt constantly a sense of futility in the monotonous daily grind of farm labor. The other members of the family had left home and were successfully employed in the city. Patient described at some length the loneliness of the farm existence, the lack of recreation, and the striving on his part to break away from the environment and equip himself to fill a more pleasant and remunerative occupation.

The strain of the responsibility resulted in a loss of interest and effort to make a success of the farm management. He again endeavored to persuade his brothers to relieve him of the responsibility, but with no success, and because of the intense fear of an older brother was forced to remain on the farm. After several futile efforts to get assistance in obtaining a vocational education he left and tried to make his way unassisted in the city. Patient had always been interested in mechanics and attempted to apprentice himself in his brother's garage. He met with no success, but was forced by his older brother into acting as runner-up in bootlegging, which his brother was conducting in conjunction with his garage. In the transporting of liquor from one State to another the brother made use of the patient as driver, feeling that his youth would be a certain protection. While transporting liquor on one occasion patient became involved with a group of Italians, also engaged in bootlegging, and narrowly escaped apprehension by the civil authorities. This experience made him realize the danger of his present situation and the fear which developed resulted in his running away and enlisting. Already a potential mental case, patient was unable to cope with the military environment, which resulted in a specific mental condition developing. Patient's reactions were at all times mild and his

hallucinatory experiences were colored by the early responsibilities placed on him and his later association in bootlegging. The persecutory delusions relative to his being pursued and harassed by the "black hand" had origin in the bootlegging episode with the Italians, which had preceded his entry into the Army.

During the period of hospitalization he developed a fair degree of insight. At the time of his discharge a slight dissociation still remained, accompanied by a residual of affect deterioration, showing that the social recovery was not complete. He returned to his community feeling apart from the family because of their lack of interest in his early welfare, and still in fear of the older brother.

The mildness of the patient's reactions and the situation to which he was returning made follow-up on this man vital to his future welfare. The case was referred to the local Red Cross chapter who had made the original investigation, accompanied by a detailed psychiatric history bringing out the patient's reaction pattern and the dangers which would ensue should he return to his former mode of living. The chapter made an excellent contact and the man's confidence has been gained and on two occasions he has been tided over situations which in all probability would have precipitated another break. His health and employment have been supervised, medical care has been given when he was found alone and without proper treatment. He was removed from work which was undesirable and placed in mechanical work, which provided an outlet for his normal interests rather than the thwarting of his personality, and where he is now finding a natural expression of himself. Without the possibility of intelligent supervision in the community to aid this mentally ill individual in his adjustments, prolonged hospitalization would have been necessary until a more complete social recovery could have been made.

To prognosticate means to indicate the course and termination of a disease. Without controls how can the physician intelligently chart and guide his patient through the complexity of social conditions, which, everchanging, like the ebb and flow of the tides, carries the patient first here and now there? Let him place the social worker at the helm to act as his control and, as the patient leaves the safe harbor of hospital life, her strategic position enables her to adjust the social conditions which influence the medical ones.

And so has social work evolved with civilization, based always on the needs as they arose. If we can look understandingly through the colored events of our patient's life, we find in our hands the many ends of a twisted scheme of things, and we may view our patient in terms of mechanism rather than diagnosis, and so attempt at least a partial readjustment.

## COMMENTS OF A VISITOR

By Blanche F. Webb, R. N., Director Visiting Nurse Society of The King's Daughters

For many years I have lived across the river from the United States Naval Hospital in Portsmouth, Va. As a child the grounds presented a marvelous place for picnics, and as an older woman a very lovely place to show visitors. In later years, as a nurse, I knew a hospital was there and nurses. I had even heard a few

years ago of a training school of some sort for sailors, a school which taught them how to care for sick and wounded on battleships. What its standards were, what its equipment or facilities, I had no idea.

In November, 1926, Miss Clara D. Noyes, director, American Red Cross Nursing Service, came down from Washington to talk before a nurses' meeting and to pay me a visit. As soon as she arrived she asked me if I knew any of the Navy Nurses. I said no, that it had never happened that we were thrown together professionally and that I knew no one then on duty in the naval hospital. She then told me of several she knew who were stationed on the reservation and of the interesting things they were doing. So I felt a keen desire to know more about their work and to know them personally. I invited one or two to come to a tea I was giving for Miss Noyes. In return I was invited to attend the graduating exercises of a class from the Pharmacist's Mates' School. On a sunny morning in November we gathered on a porch in the naval hospital grounds; nurses in outdoor uniform, officers in brass buttons, epaulets, sword, etc., were standing on the porch, which was the reviewing stand. From a distance came the sounds of gay music and we were told that the school had its own band. As the music grew nearer and nearer long lines of student corps men in spotless duck, led by the color bearers proudly carying "Old Glory" and the school flag, passed in review. A lovely spectacle this! After the review the student body and the graduating class "fell in" before the reviewing stand. The commanding officer addressed them, taking as his topic "Loyalty, Courtesy, Promptness," and as he presented the certificates, gave to each man a few words of personal commendation and encouragement. As I saw these men step out so eagerly to receive their certificates, so snappily salute when accepting them, and so cheerily march off to pack their bags and hammocks preparatory to their journey to the several naval hospitals where their training was to be continued, I just then began to visualize the plan of organization of the Pharmacist's Mates' School and the Hospital Corps of the Navy.

Following the graduating exercises the real working plan of the school was explained to us as we were escorted to the barracks where the students live, to the recreation and the study halls, and to the many classrooms. I have been in many educational departments in many training schools, but seldom have I seen such full equipment, or better organized teaching department. Laboratory after laboratory! The nursing laboratory with two model wards of 12 beds each, and two large, airy class rooms, all of which are equipped with manikins, treatment trays, charts, ample blackboard space, sterili-

zers; in fact, everything that is needed in demonstrating the treatment and nursing care for the welfare and the comfort of the sick. The dietetic laboratory is a joy to behold, equipped with all modern appliances and so arranged that each student has his own complete unit, and 20 students may carry on their practical work and experiments at the same time. From the nursing and dietetic departments we were taken to the departments of pharmacy, materia medica and metrology, anatomy and physiology, bacteriology, first-aid and minor surgery and bandaging, hygiene and sanitation, and the chemical laboratory. Every department was well organized and equally well equipped for its own particular needs.

Visiting the hospital we found the work of the student corps men there well planned under the direction of an educational head. A chief nurse who previously had been on duty in the school was responsible for the nursing instruction and the "follow-up" work in the hospital. Instruction in dietetics is likewise carried on by a qualified dietetian. The medical officers, chief pharmacists, and chief pharmacist's mates play an important rôle in the education of these young men both before and after they leave the school.

Months later occurred "Naval Week" in Norfolk. The fleet lay at anchor. I was asked by the Norfolk Chamber of Commerce to take charge of organizing and managing a first-aid station. The Norfolk nurses were all busy and I needed help, so appealed to our very good friend the commanding officer of the naval hospital for assistance, which was graciously given. He sent complete equipment across the river to Norfolk and arranged to have two senior corps men sent to me from the school each day. I had the pleasure of taking these young men with me for lunch each day to the Visiting Nurses Association, where the other members of my staff, as well as myself, were greatly impressed with their personalities. They were men well equipped with high ideals and well educated for the kind of service they were to perform.

Last year, when the Graduate Nurses Association of Virginia met in Norfolk, part of our program was a morning at the Pharmacist's Mate's School and a visit to the naval hospital. The nurses from all over the State, and elsewhere, were taken through the laboratories, observed demonstrations and equipment, saw the students drill and march. Many were the expressions of wonder, admiration, and even envy, for few hospital training schools could show such equipment. The remaining moments of this delightful and interesting morning were spent in the school auditorium, where a program of music by the school orchestra and addresses by well-known nursing leaders and others was enjoyed by the visiting nurses and the student group and school faculty.

I shall always, with great pride, escort to the hospital reservation visitors to this port, and with great delight show them what is being accomplished in one small place by members of the Hospital Corps, assisted and supported by members of the Medical and the Navy Nurse Corps.

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## A TOUR OF DUTY IN GUAM AND THE PHILIPPINES

By Sue S. Dauser, Chief Nurse, United States Navy

### Guam

It seems to be a common thing in the Navy, when one has orders for Guam, to make it an occasion for sympathy and to shower all sorts of advice and information upon the victim; but worse than all this is the profusion of tales about former experiences of others. And when one arrives in Guam he finds that his fellow men also have been victims of absurd and foolish advice and suggestions.

The tales of centipedes, lizards, rats, scorpions, spiders, mosquitoes, flies, and ants do not prove to be nearly so bad as they sound, and the bite or sting of these vicious-sounding animals contains no poison.

As there is a splendid Navy commissary store there as well as several other stores, there is no need to stock up with a year's supply of the routine necessities. If I were to have duty in Guam again, my preparation for going would be very simple. I would have a good supply of shoes, both old and new, some of leather and some of canvas, one or two good hats, and a number of light dresses. It is always well to take dress patterns of washable material to be made up there. The extensive shopping that so many do is unnecessary, for much that one buys in the States is apt to prove impracticable and is often too perishable for use in a place like Guam.

After your transport leaves and you begin your tour of duty, a very peculiar feeling comes over you. You realize that you are there, isolated from the rest of the world with no transportation to or from the island and no means of getting or sending mail. There will be a vague, indefinite schedule, possibly a ship two or three months hence. Then there is the feeling of surprise that Uncle Sam should seem to neglect some of his children in this way. But after two or three mails you begin to drift into the fact of such long intervals, and if there is no real intimate bad news in your mail, you become more calm about opening it. It is hard to describe that feeling, happy over the mail and hearing from home and yet that awful suspense bordering on fear, until you can skim through it and know that all is well with the folks so many months away. Mail comes in such quantities one can never digest it all; twice during my year in Guam the mail brought me my weekly subscriptions in numbers of 12. But aside

from this one phase, this lack of contact with the rest of the world, one can make a year in Guam very pleasant and interesting if one wishes to and will make an effort to do one's part.

One of the first things to learn is that theaters, hotels, cafés, daily newspapers, and short trips here and there are not the only forms of recreation. For most of the people in Guam, swimming takes precedence over other forms of recreation, and both daylight and moonlight afford a wonderful opportunity for this pastime. Guam is very beautiful and, though tropical, there is not the extreme heat of the other tropical stations. One finds the weather comfortable and outdoor life in any form is very enjoyable. On hikes, there need be no fear of poisonous animals or vegetation, and rare and beautiful things in nature may be found. When walking about the island one sees the simple, humble, primitive life of the native and always finds him friendly, kind, generous, and respectful. The natives are always ready to demonstrate their love for Americans.

The sea life is extremely interesting for those who enjoy it. The coral that lives and grows there forms a reef around the island and is full of unusual explorations. Wonderful colorings may be seen in this sea life. There are shells and formations that are different from anything one has experienced before.

Agana is the main and only large city of Guam. Here most of the activities center. Besides the daily movies and the open-air band concerts which are held every evening in the historical Plaza, there is a social community life of dinners, bridge, and dancing. The Plaza is an open square completely surrounded by several rows of very old, stately tall palms. Near one edge is the band stand and a small grand stand. The people congregate among the palms around the Plaza to witness all functions of the island, which may be naval or school athletic tournaments or games, holiday contests, or celebrations.

Around this plaza and facing it are buildings used for residences or to house the activities of the station. Some of these are the old Spanish buildings. One, called the Palace, is used as the governor's residence and another, the Cathedral, is the marine colonel's quarters. What was once the jail is an old Spanish building used for the pay office and for the school board office. Then there are the buildings which have been erected since the Spanish days, as the hospital, the bank, and Dorn Hall, a building used for all indoor naval functions and for daily movies.

The duty in Guam was a new experience. One part of the hospital, called Susana, is for private patients who can pay a small sum. The rest of the hospital is open to anyone living in Guam, and the service is free. One ward is all that is required for the men of the Navy and Marine Corps. The natives have great confidence in the doctors

and are very responsive and willing to cooperate in any way that the doctors advise or suggest. Surgery may be entirely beyond their comprehension, nevertheless they consent readily when it is recommended. The native girls come to the hospital for training and, when they graduate, they go back to their homes with a few fundamentals of sanitation and a knowledge of elementary nursing.

### The Philippines

The year in the Philippines is a decided contrast to the one spent in Guam. The actual duty in the hospital is not different from that in any naval hospital in the United States except that there are no veterans. One's time off duty, however, is a distinct experience.

Manila is an old and interesting city. A great part of it gives evidence of Spanish origin and influence, while other parts are oriental or native and still other parts American. It is a historical city and one can find much of interest in the "Walled City," as it is called, with its many old churches and Spanish relics and ruins. It is not unusual to see a traffic jam here as in other cities, and pedestrians, bull and carabao carts, carromatas, automobiles, and, finally, an excitable native policeman will often bring one about. Night life is found here for those who really enjoy it or for those who wish to be a spectator occasionally. There are the cafés and cabarets and, at any time, one may see strange and new sights. The Philippines are not under the prohibition law and there seems to be a tendency with some people to make the most of their time away from this law. Also, no matter how much one feels that he knows about life, he will learn more out there.

I did not have the good fortune to see and to form impressions of the non-Christian natives, the Moros of the southern islands, but the Igorotes of the mountain Provinces proved to be exceedingly unique and pleasant. They do not like to be called Filipinos. The mountain people are energetic and sincere, and intelligent enough to appreciate the guardianship of the United States. Their picturesque villages and their humble life may seem very primitive but they are a race willing to work and earn what comes to them.

Baguio is the mountain resort for the Americans. It is there that one sees the characteristics of the mountain people. Their markets on Sunday are unique and worth the trip to see. But it is never for that alone that one need go, for the magnificent mountain scenery as you wind up the trail to that high elevation, and the glimpse of native life, finally to find yourself among thousands of beautiful pines, with the long stretches of well-kept lawns and gardens of Camp John Hay, is a trip that will live in one's memory.

Many have asked me whether the duty at Guam or the Philippines was the more pleasant. That is a hard question to answer, for the

duty and life at the two stations is so different. I enjoyed them both, and am happy for memories of the experiences I had there. While on duty at Canacao I took leave to visit China and Japan. My trip to these countries was such an interesting change to break the tropical duty that perhaps others will enjoy a brief description of it.

### China and Japan

We took passage on a German ship, one of the Hamburg-Amerika Line. We boarded the ship at Manila and remained on the same ship until her return to Manila, a trip of 41 days.

The first interesting experience was meeting with our fellow passengers. There were many nationalities represented, but we were particularly interested in our contact with the Germans. We became acquainted with the ship's officers and their friends, which gave us an opportunity to learn first-hand viewpoints and ideas.

We would discuss and compare our experiences of war days. Grewsome and harrowing details, episodes that were awful or impressive were related, and these seemed all in a lifetime 10 years ago, when our whole motive seemed to be to kill each other. One man said "It was not that we wanted to kill you but our country needed us." There never seemed to be one suggestion of bitterness for all the hardships and suffering and for the loss of everything which meant the comforts of retirement. We met many old men, now working for daily wages, who had given all their wealth for war loans yet seemed contented because they had served their country. From the younger men, men who were too young to be soldiers in the days of war, we heard minute details of their home life during the war. They told us about living on turnips. Their soup, their cereal, their jam, and even their coffee was made out of turnips. These grow with practically no care, and in rocky and poor soil where nothing else would grow.

Hong Kong was our first stop and we saw it again for one day on our return trip. It is really the beauty spot of China, if one can call it China, for it is really British soil. The approach and the harbor are most impressive. The mountains rise directly out of the water and make an irregular shore line all around with the city at the base of one and magnificent residences at all elevations above it. From the ship at night, it is like a huge Christmas tree.

There are some beautiful trips around Hong Kong. The first one, perhaps, is the "Peak," from which one gets an awe-inspiring view. Going up to the Peak, one passes through a very interesting military post. On the other side of the island, from the porch of Repulse Hotel, overlooking Repulse Bay into the distance beyond, is a view that is not easily forgotten. The gardens are terraced from the

hotel to the water's edge, and we saw it when the poinsettias were at their best. One can find good shopping in Hong Kong. Perhaps the bargains may not be quite so good here for certain things as in other parts of China, but in ivory and shawls one finds the best selection with very good prices.

Shanghai comes to my mind as the city of dirt, filth, poverty, and suffering. When I saw the photoplay "The Volga Boatman" with all those depressing scenes, human beings undergoing beast labor hardships, I could not believe that I should ever see it in real life. In the country behind Shanghai we saw teams of 15 and 20 human beings in harness pulling big boats along the canal. But, unlike the famous show, there was no music of the "Boatman's Song" to help draw the heavy burden. Unlike the play, also, we saw more women and half-grown children than men in the harness.

As we rode back to town along the Rubicon we saw unbelievable human existence, conditions that one could hardly comprehend unless one saw them. From our ship we saw much of the life of the thousands of families living in houseboats. We saw them scramble for every particle of garbage from the steamers. Mere children would take their stand to manipulate the sampans and they would greedily devour the refuse out of the dirty water. We saw tiny children at play on the house boats; some were tied with a line, others were not, the precaution taken that the boys would not fall overboard.

In our eagerness and plans to see Peking we thought little about Tientsin. We stopped there en route, but after a little sight-seeing we hurried on to Peking. Our impressions of Taku and Tanku, where we left the ship for the railway, will always be most vivid to us. One can never forget the bitter cold wind from the north that told that Siberia was near. All along the banks were groups of mud houses, the size and shape of the igloo in Alaska. These were the homes of the Chinese of that part of the country. Later, when on the train, all the way from Tientsin to Peking we saw scattered throughout the country many, very many, of the same shaped mounds, only much smaller and no openings in them. "When we put them below they don't need big houses," was the way it was explained to us.

Peking is real China, with its stolid, stoic, heedless indifference, with all its dirt, filth, and congestion, yet so ancient and historical. All Peking is picturesque, and it is so proud of its summer palace, its winter palace, its temple of heaven, its bell and drum towers, its observatory and museums, and many sacred temples and Buddhas, all evidence of glorious history, yet all falling into decay and ruin. When one sees and realizes the spirit of Peking one wonders if the foreigner will ever touch or change any phase of it. Their

ancient superstitions and practices are so different from ours and so indelibly inborn.

We were fortunate to be able to witness one of their religious services in the Lama Temple. It would be extremely difficult to describe it, one must see it to comprehend it, but the impression it left with me is that there must be faith beneath such prayer and demonstration. At the entrance to this temple was the largest number of beggars we had to contend with at any one time in China. Everywhere one is followed by some, but at this temple they were in such numbers it was difficult for the guide to get through the court in front of the temple. He cautioned us not to give anything, for any encouragement would completely stop further progress through the crowd.

The famous old Wagon-Lits Hotel was far better than expectations; the shops were everything one could desire, and our sightseeing most successful and satisfactory. I brought away with me not only pleasant memories of Peking but also a very pretty picture of our last sunset. We were returning from a trip to the western hills, the coloring in the sky was glorious, and on the edge of a small pond among some trees and reflected in the water was a group of camels as they rested on their homeward journey, after a long day to the markets of Peking.

From Peking we had to go to Chinwangtao to join our ship. We could not get a berth, so we started at 8 p. m. for an all-night trip, sitting up in what they called a "first-class" car. It was the dining car, but not what we think of as a dining car or a parlor car. The porter from the hotel saw that we were settled and explained about Chinese travel and trains. After he left us we looked around and discovered that we were starting out on an all-night ride in a crowded car and not one white man or another woman in all that crowd. About every two hours they would come around to look at tickets; this ticket party always consisted of seven men, two of whom would be soldiers with guns and bayonets.

It was too cold and drafty to relax or sleep in our seats, nor did many of our fellow passengers sleep. It seemed they must have been men of wealth, for they wore many garments of beautiful heavy silk, some lined with fur. They seemed to buy little or no food from the train supply, but at the frequent stops they would buy fat roasted brown Peking ducks, pull them apart and eat them with real relish. They ate them without anything else in the food and drink line.

We arrived at Chinwangtao in a snowstorm, and no sightseeing could delay our haste to thaw ourselves out in the steam heat of our ship. After a day there we started for Dairen, our first Japanese port.

We found this section of the country interesting; its commercial size and importance was a revelation, and its history in the Russo-Japanese War made Port Arthur particularly attractive. We saw a great deal of Japanese military life there. It was there also, in the Chinese city, that we saw the first small girls with bound feet. Everywhere we had seen women struggle under that dreadful handicap, and I was almost ready to think it was true that it was not done any more, but the European people living out there told us it was still being done, especially in districts inland or away from the commercial ports.

Tsingtao was our next port, a city in China built by Germans. There must have been thrift and prosperity when it belonged to Germany. It is still a beautiful city, beautifully situated and well laid out, with good, substantial houses and buildings. But already all this is showing heedless neglect of a different civilization, for apparently the Chinese do not want our western comforts and modes of living. We saw it when it was celebrating some anniversary of the return of the city to China, typical oriental festivities in a city built by western civilization.

We were in Kobe long enough to be able to see "Old Japan" in trips to Kyoto, the city that was the capital of Japan for over a thousand years, and Nara, the ancient sacred city.

Kyoto is to be remembered not only as an excellent shopping place for real Japanese antiques and arts, but also as a city full of history and relics. One can see many shrines and temples, famous in the tradition and history of Japan, which will be remembered because of their settings, grandeur, and architecture. Kyoto takes pride in preserving the old régime of things in spite of the changes sweeping over the country by modern progress.

Real beauty is found in Nara. It is fairylike in its settings for sacred shrines and temples in gardens on wooded hills and groves. The first shrine we were to visit took us along a path through a park where about 800 deer roamed and wandered about. They would come up to us in our rickshaws in a most friendly manner and beg for a little petting or a tidbit to eat. Some ancient diety in Japanese legends made a perilous journey on the back of a deer, and for this reason the shrine has continued to keep deer. Feeding them wins the same favor from this god as would an offering at the temple. As this same path curves and winds up a small hill, it becomes more and more shaded by very old spreading trees and is bordered by lanterns, most of them of stone, some of brass, many thousands of them of all shapes and sizes. At the end of this path, and amidst many more lanterns, is the shrine. In one corner a group of maidens clad in elaborate white and red vestments danced an ancient religious dance for us.

One can not go into the detail of all the beautiful and interesting sights of Nara, but one other must be mentioned, that is the Daibutsu of Todaiji. The age, size, and art of this piece of work is stupendous. It is the largest image in Japan; it weighs about 450 tons and was made in 749 A. D. Some of the pieces, as the lanterns around it, are considered the finest pieces of bronze work in the world.

What one sees of Japan in these cities or from the trains coming and going makes one think of picture books and fairy tales. Everything is artistic and beautiful, the hills are terraced and cultivated. Everywhere the homes and fields are neat and well kept. As a country Japan is perhaps more beautiful than I anticipated.

In spite of all this artistic beauty of Japan, China, with all its filth and congestion and poverty, will hold one to a much greater degree. Her people and her history have a deeper fascination, her problems, sufferings, and struggles grip one's heart with lasting impressions. One can not see all this in China and forget it as soon as one leaves, and no one can think about China and not be thankful that America is his home.

## NOTES AND COMMENTS

### REVISION OF THE ANNUAL PHYSICAL EXAMINATION REPORT FORM

The blank for reporting the annual physical examination has been carefully revised. It was so designed as to accomplish several distinct purposes and in many instances deviations from the ideal were necessary to effect a compromise among the several specifications laid down for the revised form. The most important was to incorporate an automatic coding system in conformity with the statistical code in use for other purposes in the bureau. Heretofore all coding had to be done by reading each individual report, attempting to evaluate answers, which too frequently were ambiguous or doubtful, and writing in pencil the proper code numbers, many of which had to be looked up. This is obviated in the revised form by (1) having printed with a code number every defect which has been recorded fifteen or more times a year during the last two years; (2) by having printed a diagram of ranks and corps with code numbers; and (3) by having printed a diagram for recording blood pressure in such a way that readings will be automatically grouped and appear under proper code numbers. By punching these code numbers on a statistical machine the card illustrated in Figure 1 is completed, so that it becomes punched as shown. Such cards are then run through sorting machines which sort and count them.

A corollary of the first specification was the absolute necessity of elimination of ambiguity by sharp demarcation of answers. The questions as framed are by no means the best possible and they are not intended to interfere with the examiner and his methods, but for the sake of statistical study he must interpret his findings and report them in a common language. Synonyms with slightly different shades of meaning vitiate statistics. All measurements and figures must be whole numbers because fractions can not be punched on statistical cards and it is easier for the examiner to estimate to the nearest whole number than it is for another person on the basis of recorded data.

The specification next in importance was to reduce the necessary typewriting and clerical work at the source to a minimum. To this end sufficient descriptive terms were printed to enable the examiner to choose one that applies and check it. Of course everything could

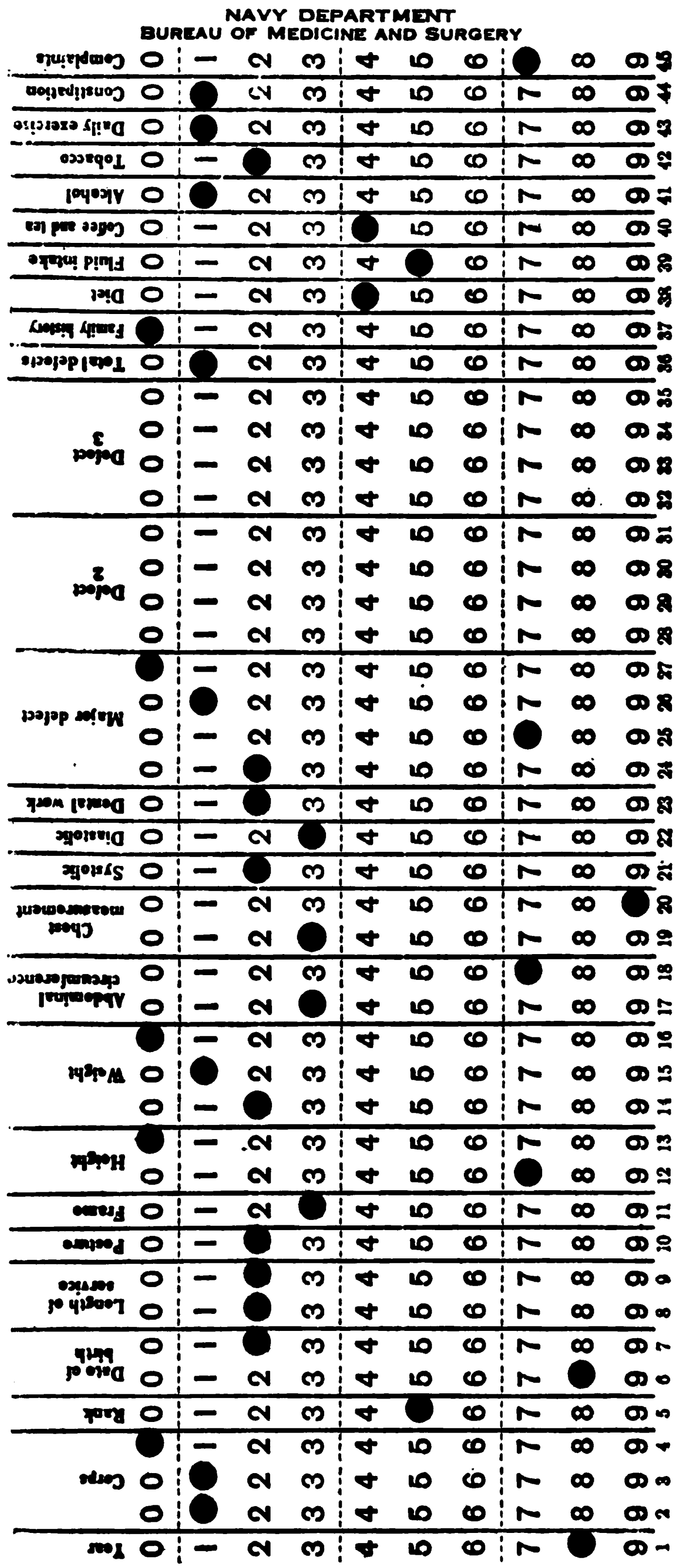


Fig. 1.—Revised annual physical examination code card

not be printed, and it was attempted to strike a happy medium and relieve the examiner from the necessity of writing routine repetitions. Where the printed terms are inadequate the examiner will use his own words. Words that do not apply should be ignored; no mark of any kind is needed to indicate the fact. However, each question must be checked so as to indicate normality or abnormality. A question not answered one way or another implies that it has been overlooked and is of no value.

Another specification was to eliminate sending letters to medical officers calling to their attention defects found. A board of medical officers made a recommendation, the report was sent to the bureau, and at times everything was held in abeyance pending action of the bureau in the case. What happened? Thousands of these forms reached the bureau and that particular form was not read until months later. Did or did not the medical officer having custody of the health record serve on that board? Did he know the recommendations of the board? A letter had to be written him. In the revised form all this confusion and guesswork was to be eliminated. The medical officer having custody of the health record was designated in the revised form to forward the report after reading it and subscribing to a statement that he was responsible for initiating action—be it hospitalization, request for survey, or otherwise.

A further specification was to group the questions so that all information obtainable and examination possible while the person was fully dressed should be completed before requesting him to strip.

The form was to replace all or as many of the various blanks used for reporting physical examinations as possible. With the exception of the form used for aviation examinations, it probably will later replace all others. Annual examinations of aviators will have to be reported on both forms. The new form for annual physical examination can be completed by the clerical assistant at the same time as the aviation blank while the examiner carries out a single examination. This apparent duplication of effort can not be avoided unless all aviators are dropped from statistical studies. The latter alternative is not desirable, in view of the fact that the human element is still the weakest link in aviation.

Additional specifications dealing with size of paper, single or double sheet, size when folded, economical cut from stock sheets, etc., are of no interest to the medical man except in so far as they serve to indicate limitations.

Experience has demonstrated that a layman can not write a medical history of his case. It is not necessary to stress the importance of personal medical history to medical men. A good history, of value in detecting incipient disease, of value in applying principles

of preventive medicine, of value in understanding the patient, can only be obtained by one trained in medical science. The medical history, therefore, will in the future be obtained by a medical officer, who is supplied with a form which can be easily checked as he interviews the officer concerned. Again the form is designed to reduce writing to a minimum and carries code numbers for certain data.

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## SCIATICA

The Hunterian oration was delivered February 27, 1928, by Anthony Feiling, M. D., F. R. C. P., who chose for his subject "Sciatica: Its varieties and treatment." The oration was published in The British Medical Journal, March 10, 1928.

Sciatica may seem a peculiar subject for a Hunterian oration, but Feiling says:

> I make no apology for the choice of my subject for this oration, trite though it may at first sight appear. The aggregate of suffering and of disability in the shape of work and wages lost through this common disorder is sufficient excuse for any attempt to clarify its causes or rationalize its treatment.

"Sciatica," to the lay mind, means any pain about the hip, buttock, leg, or lumbar spine, no matter what its cause may be. To the physician it should mean pain in the distribution of the sciatic nerve and nothing more. It should not be thought of as a disease entity but only as a symptom.

For purposes of convenience the author divides sciatica into two types, (1) a secondary or symptomatic sciatic and (2) a primary or essential sciatica, but he admits that there is probably no such condition as the latter, all sciatica being due to some pressure somewhere.

Secondary sciaticas may be due to tumors of the rectum or pelvic organs, growths of the bones of the pelvis or vertebral column, disease of the hip joint, sacro-iliac joint, or of the lumbar vertebrae; disease of the nerve roots of the cauda equina (syphilis or tumor); old injuries and diseases of the spinal cord (tabes). Osteoarthritis is frequently overlooked.

The presence of any of the following signs or symptoms makes doubtful the primary nature of the sciatica:

> (1) The distribution of the pain in any of the following areas: (*a*) The anterior aspect of the thigh; (*b*) the perineum, groin, or genital organs; (*c*) the abdomen or abdominal wall.
>
> (2) A motor paralysis of the leg or thigh or even a dropped foot.
>
> (3) Loss of the knee jerk.
>
> (4) Any marked muscular atrophy.

(5) The presence of the reaction of degeneration in any of the muscles showing slight wasting.

(6) Any severe vasomotor disorders, and, of course, any such signs as edema or trophic ulcerations.

7. Any interference with the nervous control of micturition, defecation, or the sexual functions.

8. Lordosis, or a gross deficiency in the movements of the spinal column.

9. Finally, the history of an operation for malignant disease should immediately raise doubts as to the innocency of any sciatic pains.

Primary sciaticas are divided by Feiling into two groups:

(1) Those where the symptoms suggest that there is a neuritis of the trunk of the sciatic nerve itself—a true sciatic neuritis; and (2) those where there is no direct evidence of such a neuritis, but where there seems reason to believe that the seat of the trouble lies higher up in the region of the lumbo-sacral vertebræ.

True neuritis of the sciatic nerve does exist, but its etiology is generally uncertain. Foci of infection should be looked for, although the author states that he meets with little success in this respect and can not recall a single case that has been benefited by the removal of such foci. This form of sciatica is frequent in diabetics. In primary sciatica, the sensory functions are affected out of proportion to the motor functions, whereas in sciatica due to gross-pressure lesions the motor functions are greatly affected.

Extending the leg with the thigh flexed on the abdomen will cause pain in both types of sciatica. Direct pressure on the nerve produces tenderness in neuritis of the nerve trunk and is the simplest diagnostic procedure.

In true neuritis the ankle jerk almost invariably is absent.

The most common form of sciatica is sciatic neuralgia. This is of uncertain origin. In it there is little or no tenderness of the nerve trunk and it is common for the pain to radiate, especially in the distribution of the fifth lumbar nerve.

Scoliosis is often associated with sciatica and is most often contralateral in type. Attempts to correct the scoliosis cause pain in the distribution of the sciatic nerve. Associated with this there is usually rigidity of the spine.

The author believes that in a large number of the so-called primary sciaticas there is a lesion higher up in the region of the lumbar vertebræ, and he bases his views upon those of Sicard and Putti and others of the French school, who classify neuralgic pains in the distribution of a spinal nerve root, nerve plexus, or nerve trunk as follows:

1. Neuralgias due to lesions of the posterior nerve roots within the spinal theca; to such the term "radiculitis" has been applied.

2. Neuralgias due to lesions between the posterior root ganglia and the origin of the nerve plexus. This condition Sicard has called "funiculitis," the funicu-

**lus being the name given to that part of the nerve root between the ganglion and the plexus. (It will be noticed that the funiculus is that part of the nerve root which is mostly contained in the bony canal formed by the intervetebral foramina.)**

**3. Neuralgias due to lesions either of the nerve plexus or of the nerve trunk itself.**

Radiculitis is comparatively rare, as it is a lesion within the subarachnoid space, while funiculitis is more common because the funiculus is so located as to be subject to traumatic and arthritic lesions. Because most lesions are extrameningeal, the neuralgia is usually unilateral.

In radiculitis, according to Sicard, the cerebrospinal fluid will show a lymphocytosis, while in funiculitis there is an increase in protein without any increase in cells.

As to why sciatica is so common, the author is of the opinion that anotomical conditions are responsible. The small size of the foramina between the fifth lumbar vertebra and the sacrum and between the fourth and fifth lumbar vertebrae is of importance.

Danforth and Wilson think that sciatic pain of the type under consideration is a symptom of some disturbance in the lower lumbar spine. The lumbo-sacral joint is the most frequent site of the lesion and the fifth lumbar nerve is most frequently involved.

Feiling believes that, in spite of the anatomic relationships, disease of the sacroiliac joint is a rare cause of sciatica. He acknowledges, however, that in America this casual relationship is generally accepted.

In diagnosis X rays are of little help unless there are bony lesions. Muscular and ligamentous lesions may lead to scar tissue which catches nerve fibers and produces pain in the distribution of the sciatic nerve.

Treatment, to be curative, must be based upon correct diagnosis; palliative treatment, however, frequently gives temporary relief.

In cases where there is real neuritis or perineuritis rest in bed is almost always essential. Splinting is not advised by Feiling because of the discomfort caused the patient by keeping the limb in one position for a long time. The application of heat by poultices, fomentations, radiant heat, or diathermy is the most useful local treatment.

Electricity is seldom used by the author and he has found counter irritation of little benefit in severe cases. Massage is contradicted if acute neuritis is present.

Constipation and urinary infections must be relieved. The salicylates and iodides are the only drugs that seem to have any direct effect on sciatica.

Analgesic drugs are usually necessary, but morphine, for obvious reasons, should be avoided.

Cases which do not yield to these simple measures in two or three weeks may be treated with injections of saline solution into the nerve trunk. The best sites for the injection are just below the sacro-sciatic notch and at a point on a level with the tuberosity of the ischium. The point of the needle must enter the sheath of the nerve before the saline is injected. Feiling uses 100 cubic centimeters of the solution for injection. The pain which follows is sometimes severe but does not last long and may be controlled by morphine. The patient should remain in bed for 24 hours after the injection, and it is frequently advisable to repeat the injection at some other point in the nerve after three or four days.

Injection of oxygen has been tried with success in some cases.

Incising the nerve sheath has brought relief in some cases which have resisted all other methods of treatment.

In cases of "central sciatica"—that is, those in which there is a spinal arthritis—injection of the nerve trunk is of little value, but temporary relief may be given by an epidural injection. A needle is passed into the sacro-coccygeal foramen and the solution is injected into the epidural space. Normal saline, novocain, or a 40 per cent solution of antipyrine may be used. The author prefers to use 10 to 20 cubic centimeters of the antipyrine solution. The relief afforded by this is immediate. Protein shock therapy is also advocated.

Putti finds immobilization by means of a plaster jacket, followed by a celluloid corset of great value, but Feiling, in the more chronic cases of this kind, has observed great benefit from manipulations under an anesthetic.

In conclusion, the author says:

> With this sketch of the treatment of certain forms of sciatica my remarks must be concluded. This disorder, so common and yet so crippling, affords the widest scope for the exercise of our science and our art, and although its care may not excite the admiration of the crowd or intrigue the fancy of the aspiring student, its many difficulties, diagnostic and therapeutic, will be amply rewarded by the gratitude of the patient who has been successfully and permanently relieved.

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## BACTERIOPHAGE

Whether or not bacteriophage present in the blood stream of a pregnant animal could pass through the placenta and be found in the blood stream of the fetus was the problem studied by John E. Blair and David L. Reeves, of Stanford University. Report of their experiments was made in the Journal of Infectious Diseases, May, 1928.

An antityphoid bacteriophage was used in the tests. Three pregnant guinea pigs were injected intraperitoneally and three others

were fed daily 2 cubic centimeters of the bacteriophage. The results in all cases were negative.

The activity of the bacteriophage was then increased and used in another series of experiments. A guinea pig injected intraperitoneally with 5 cubic centimeters of this highly potent bacteriophage showed the presence of the substance in its own blood and intestinal contents, and the young, born within 24 hours, also showed bacteriophage in their blood and intestinal contents.

An animal fed with bacteriophage showed its presence in the feces, but the blood and intestinal contents of its young, born three days after the last feeding, were negative.

Other experiments also were conducted which demonstrated that bacteriophage of high potency may be transmitted through the placenta.

Inasmuch as the bacteriophage is estimated by various experimenters to be from 5 $\mu\mu$ to 30 $\mu\mu$ in diameter, the authors consider it impossible that it is transmitted from mother to fetus by diffusion.

## APPENDICITIS

The R. W. Stewart Memorial Lecture before the Pittsburgh Academy of Medicine was read by Dr. John B. Deaver, February 28, 1928, and was published in the Journal of the American Medical Association, May 26, 1928.

Doctor Deaver chose for his topic "Appendicitis," and there is no one better qualified than he to discuss this subject.

It is to be hoped that all medical officers will have read the lecture in its entirety. For the benefit of those who may not have done so, some of the points brought out will be given below.

Operation should not be delayed, because it is thought that the case is nonperforative. It is not always possible to determine this point, and even if there has been no perforation there may be a gangrenous or phlegmonous appendix. Doctor Deaver's wide experience has led him to the conclusion that the clinical signs and the pathological changes do not always agree.

In the diagnosis of acute appendicitis the history of the attack is of great importance. There is always pain in the periumbilical region or epigastrium followed by vomiting, which ceases when the pain becomes localized in the appendix region.

As to the location of the appendix, Deaver says that it lies lateral to or behind the cecum and ascending colon, and points upward, in 60 per cent of cases. In 30 per cent it lies in the pelvis and points downward, while in the remaining 10 per cent it is below the apex

of the cecum, along the mesial side of the ascending colon, or beneath or above the terminal mesentery or ileum.

If the appendix is in the first position the pain is referred to the region of the cecum, high up, or to the loin. If in the pelvis, the pain will be low down in the abdomen and on the left side. In the other positions the pain is referred to the left side either high up or low down.

The position of the appendix may usually be determined if the case is seen before distention occurs. Gentle and light palpation along the line of greatest tenderness will lead to the appendix. If the patient is not seen early, it is not always possible to locate the appendix accurately.

As is well known, the position of the appendix is a large factor in deciding the relative severity of the attack. If high up, lateral to or behind the ascending colon, the danger is greatest. If in the pelvis, the danger of fatal toxemia is least, as the pelvic peritoneum is most tolerant to infection. A collection of pus lateral to the cecum is less dangerous than one on the inner side of the cecum close to the small intestine. According to Deaver, anatomic and physiological rest offers a better prognosis than hurried operation in cases of appendical abscess centrally located and surrounded by coils of intestine.

Various conditions may make the diagnosis of acute appendicitis doubtful and thus delay operation, which accounts for some of the high mortality from acute appendicitis. An even more important factor in the high mortality is stated by Deaver to be "precipitate operation in the presence of peritonitis." Still another factor is failure to remove the appendix as soon as the patient has recovered from the acute attack.

Fortunately, most of the conditions which make the diagnosis of acute appendicitis doubtful call for immediate operation, so there should be no delay occasioned by the uncertainty.

The most important signs of acute appendicitis are tenderness and muscular rigidity. Exquisite tenderness means pus. The polymorphonuclear cell count is of great importance, but Deaver finds it difficult to understand why a diagnosis can not be made before the leukocyte count is known or why operation should not be advised if there is no leukocytosis.

Left-sided pain means that the appendix is in one of the lower positions. When very low down there is frequently vesical tenderness. In these cases rectal and vaginal examinations are of much value. There may be inability to void urine freely. These patients should be catheterized.

The importance of making use of the anterior longitudinal muscular band of the cecum, the ileocolic (vascular) fold of peritoneum, the illocecal fossae, and the subcecal fossa as guides to the appendix is stressed by Deaver.

As to the choice of incisions, Deaver says:

In the presence of a mass or collection lateral to the colon and cecum or below the cecum, the extraperitoneal approach through an incision carried to the lateral side of the swelling and through the underlying abdominal muscles down to the transversalis fascia, which is usually found infiltrated, enables the surgeon to evacuate the collection and in the majority of instances to remove the appendix with the minimum amount of intraperitoneal dissection. * * * To attack these collections by first opening the peritoneal cavity adds materially to the mortality * * *.

By using this method of approach Deaver finds it possible to remove the appendix in practically all cases except those in which the collection is completely walled off. In those cases he simply evacuates and drains and removes the appendix later when the patient has recovered from the drainage operation.

If there is a collection of pus in the pelvis, Deaver makes the incision low down lateral to the rectus muscle. If the collection in the pelvis is central and can be felt above the pubis, he catheterizes the bladder and makes his incision in the median line. In this case evacuation and drainage are all that is done.

In cases showing a well-circumscribed collection in the central area of the abdomen Deaver opens and drains the abscess, after the peritonitis has subsided, and removes the appendix later.

For the ordinary acutely inflamed appendix, the McBurney incision or the approach through or lateral to the rectus muscle is preferred.

Deaver considers the appendix the most important focus of infection, not excepting the tonsils, teeth, and sinuses. He is convinced that practically all upper abdominal surgical ailments are primarily due to infection in the appendix.

In all acute abdominal conditions, except those clearly due to obstruction, the appendix should first be considered. It should also be the last thing thought of if no other cause can be found.

Secondary collections of pus due to appendicitis are most frequently found "(1) in the immediate neighborhood of the site of the appendectomy; (2) in the pelvis; (3) beneath the liver or between the liver and the diaphragm (subdiaphragmatic); (4) centrally in the intestinal labyrinth; (5) in proximity to the spleen; (6) under the left diaphragm."

Treatment of acute appendicitis is fully discussed. According to Deaver, it should always be surgical and never medical, although "anatomic and physiologic rest" is the correct treatment for ap-

pendical peritonitis. Operation should be done as soon as the diagnosis of acute appendicitis is made, provided peritonitis does not forbid it.

In the fulminating appendicitis which follows a large perforation, operation should be done at once, if the patient is seen early.

In all cases the appendix should be removed before peritonitis sets in. If this can be done, there is little risk involved in the operation.

The position of the appendix determines the method of approach. If it lies close to the cecum and is directed upward and lateral, use the extraperitoneal route. Contamination is avoided by gauze pads. After the appendix is removed fluid in the pelvis is aspirated through a glass tube and if organisms are found in a smear of the fluid the tube is left in place.

In circumscribed peritonitis, where there is an abscess at the ileocecal junction or beneath the terminal ileum and the mesentery and there is thickening of the terminal ileum, Deaver, after removing the appendix, performs an ileocolostomy.

Patients with diffusing peritonitis should not be operated on until the peritoneal inflammation has subsided. They should be given "anatomic and physiologic rest" by the Murphy-Fowler-Ochsner treatment. Even the most severe cases sometimes recover under this form of treatment.

Where diffusing peritonitis has left multiple foci of pus, death usually results from toxemia, whereas, if only a single abscess in the pelvis or lower abdomen remains, recovery will usually follow drainage.

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## EPILEPSY

Medicine, May, 1928, contains but one paper, an exhaustive study of epilepsy from the standpoint of physiology and treatment, by William G. Lennox and Stanley Cobb, of the department of neuropathology of the Harvard Medical School.

Epilepsy is defined by the authors as "a syndrome characterized by the sudden appearance of paroxysms, of which convulsive movements or loss of consciousness or both, are a principal element."

Judging from the reports of the draft boards there are about 500,000 persons in the United States subject to epilepsy. The cost of their care is enormous. No great progress has been made in the methods of treatment used for these sufferers.

According to the authors, "fits can be set off by disturbances in various parts of the central nervous system," and it can not be said that all of these phenomena are "pyramidal," "extrapyramidal," or "medullary."

Four theories are discussed:

(1) The "Irritation" theory which arose from the electrical excitation experiments and the pathological findings in Jacksonian epilepsy. (2) The "Release" theory suggested by recent advances in physiology. * * * This theory holds that convulsions come * * * from a temporary suspension of function of the higher centers which allows the lower centers to discharge explosively. (3) The "Short-circuit" theory * * * allied to the release idea. * * * A cortical lesion (for example) is considered capable of interrupting enough association fibers to check the normal spread of nerve impulses and cause them to take a shorter, abnormal route, leading to explosive discharge. The * * * release theory deals in physiological levels as units, whereas the short circuit conception may be used to explain an epileptic discharge from any anatomical lesion. * * * The two, however, may well be combined. (4) The "Explosive" theory negates these * * * by holding that a seizure arises as a general widespread change in brain tissue * * * dependent * * * upon some sudden metabolic change—such as anaphylaxis, anoxemia or alkalosis.

The authors state that no one of these theories is satisfactory and that all seizures are probably combinations of two or more of these mechanisms. They believe that "epileptic seizures are neurological phenomena, usually motor, caused by some sudden change in the nerve cells."

In most institutional cases gross lesions of the brain are found, but no specific lesion of the nervous system has been found. "Almost any lesion plus the unknown, X, which we call functional instability, may result in epilepsy."

Evidence is presented by the authors to show that conditions which affect oxidation, the equilibrium of electrolytes and acid-base elements, permeability of cell membranes and edema, may play a part in producing convulsions.

The importance of psychological factors is recognized, but attention is called to the fact that these factors "must act through physiological processes—such as changes in blood flow through the brain or in the physiochemical processes in nervous tissue."

Abnormalities outside the central nervous system are discussed. These are considered only contributory to those within. There is no one abnormality common to all epileptics.

The circulatory system may be involved and, as it has been shown that the cerebral arteries are under vasomotor control, vascular spasm may be a cause of fits.

The autonomic nervous system, respiration, and the gastrointestinal tract have all been studied with reference to epilepsy. The authors find no proof that these play any important part in the causation of seizures.

Many epileptics show decreased oxygen consumption. Lennox and Cobb think this may be a mechanism of defense, as artificial stimulation often increases the seizures.

The part played by the endocrines in epilepsy is not thoroughly understood, but "only a few patients having seizures present clinical evidence of endocrine abnormality." It is of interest that the same conditions which precipitate seizures in epileptics may bring on tetany in parathyroidectomized animals.

The authors find no evidence of any abnormalities in the morphology, physical properties, or Wassermann reaction of the blood which might account for seizures.

As to the spinal fluid, these investigators say:

> There is little clinical evidence that abnormal pressure in itself induces seizures or that reduction of pressure alleviates symptoms, except in the condition of status when spinal drainage is often of distinct benefit. * * * Examination of patients with epilepsy by means of lumbar puncture reveals some abnormality in more than one-half.

Whether or not there is a convulsion-producing toxin in the blood of epileptics has not been proved. Various experimenters have claimed to have found such a substance, but their experiments have not been well controlled.

Although an occasional epileptic shows evidence of allergy, there is no proof presented that attacks are influenced by eating meat or other proteins.

Apparently carbohydrate metabolism plays no part in epilepsy. Further study should be made of fat metabolism in epileptics.

"We believe," the authors say, "that in patients with epilepsy in the interparoyxsmal periods the acid-base balance in the body fluids is essentially normal. Within the normal limits, there may, however, be an abnormal degree of variation from day to day. During and immediately after seizures, as a result of asphyxia and muscular contraction, there is a temporary condition of acidosis. * * * Alkalosis induced in epileptics by the administration of alkali or by overventilation may be followed by seizures. It is probable that anoxemia and possibly other related chemical changes in nervous tissues play a part in inducing seizures. * * * Acidosis, whether induced by rebreathing, by ketosis, or by the administration of acid or acid-forming salts, in some patients causes a reduction in the number and severity of seizures. * * * The beneficial effect of acidosis is not due to changes in pH alone, but to related changes in the physicochemical reactions of nerve cells, which result in a decreased irritability of the nerves * * *."

Since epileptic seizures are only symptoms, it is the duty of the physician to conduct painstaking search for their cause or causes. Lennox and Cobb advise the following course in making the examination:

A detailed history should be obtained. Anything which will throw light upon the patient's physical, mental, and emotional make-up is

important. Seizures should be classified as "hysteria, Jacksonian epilepsy, and other types of seizures." There is no particular characteristic of a seizure which will justify its being called "symptomatic" or "essential." Eye grounds and visual fields should be studied with care. The cranial nerves, sensory and motor functions, posture and gait, and the stability of the autonomic nervous system should receive consideration.

Examination of the blood, urine, and feces should be made and, in addition, X-ray examination of the skull, possibly also of the gastrointestinal tract. The pressure of the spinal fluid should be determined, with and without jugular compression, and the number of cells, amount of protein, and the Wassermann and gold sol reactions of the fluid must also be studied. By doing this light may be thrown on a few cases which will be of assistance in their treatment.

Do not wait until the "epileptic habit" is established. Treat early; then some good may be accomplished.

As to prophylaxis of epilepsy, the authors consider that eugenics may be of assistance. Birth trauma and prolonged asphyxia, which seem to be productive of epilepsy in some cases, should be reduced to a minimum. Meningeal hemorrhage calls for drainage or decompression. Meningeal infection and head trauma should be prevented and psychic trauma should be treated early.

Treatment should be directed toward removing or correcting abnormalities found by physical and laboratory examinations. Hygiene, diet, and medication should receive careful attention.

Mental hygiene is especially important. Patients should be protected from emotional strain and should not be sent to special institutions unless deterioration has already taken place.

Work, exercise, rest, sleep, habits, should all be carefully supervised in order that the patient may be kept in the best possible physical condition. Proper posture must be insisted upon. Physical exhaustion must be guarded against.

Food should be simple and nutritious and only enough to meet requirement, but there is no necessity for prescribing a strict diet of any kind, except in children who may have to be placed upon a ketogenic diet.

Bromides have long been used in the treatment of epilepsy. Combined with a restricted salt intake it has reduced the number of seizures materially. At present phenobarbital (luminal) is the drug used to control seizures. It is less depressing to the mentality than the bromides. The usual dose of luminal is 1½ grains a day. Luminal-sodium is more soluble than luminal and may be given subcutaneously or intravenously. One patient of the authors was having 15 to 20 seizures every day. He was given one intravenous

injection of 10 grains of luminal-sodium and was free from seizures for four days.

In cases of status epilepticus, drain the spinal fluid and give 5 to 10 grains of luminal-sodium intravenously. Inhalation of a mixture of 10 per cent carbon dioxide and 90 per cent oxygen is recommended. Fasting or the administration of cream, butter, or oil, with plenty of water, should help by producing ketosis. Magnesium sulphate in 50 per cent solution helps by reducing intracranial pressure, increasing acidosis, and cleaning out the bowel.

Of the use of sedatives in epilepsy the authors say:

In some patients the use of sedative drugs apparently eliminates a certain proportion of the seizures. In others it seems to dam them up in the organism, to be released in a flood when the drug is discontinued or the body breaks away from the sedative's control.

Much remains to be learned about epilepsy, but the authors of this paper are hopeful, for they say, in conclusion:

* * * Finally, no one can doubt that continued study and search will bring a better understanding and a more rational and effective treatment of this distressing symptom.

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### THE USE OF LIPIODOL IN THE DIAGNOSIS OF PULMONARY CONDITIONS

Much attention has been directed by roentgenologists recently to the use of lipiodol in the roentgen examination of pulmonary conditions. Heretofore it has seemed that the use of lipiodol for chest examinations has required a technique of administration fraught with considerable danger and extreme discomfort. In the opinion of many observers this diagnostic procedure was often more serious than the suspected pathological condition.

In Minnesota Medicine, March, 1927, reprinted in The Radiological Review, May, 1928, A. H. Beard, M. D., of the University of Minnesota, discusses the use of lipiodol and the various methods of injection for roentgen examination of the chest in the light of recently developed and improved methods of injection, as follows:

Iodized oil, or lipiodol, as it is better known, is a clear, amber yellow fluid. Chemically it is 40 per cent iodine held in poppy oil. It has the specific gravity of 1.350, is neutral, and is insoluble in water and alcohol. The iodine is held so closely that it can not be detected as free iodine by any chemical tests. The opaque and antiseptic qualities make it very effective for examining various cavities by X ray. The liberation of free iodine when exposed to the air, light, humidity, and high temperature gives it a dark brown color, and when this occurs it should not be used. As it is opaque and nonirritating to the mucous membrane, it can be used without discomfort in mapping various cavities in the body. It has been used to examine special cavities, as subarachnoid and epidermal spaces, spinal cord conditions as compression and tumor masses, and the uterus and fallopian tubes by the gynecologist without danger. Any blind

cavities, as fistulæ, etc., are easily followed with lipiodol. The greatest use seems to be in chest conditions where the bronchial tree can be studied. It is surprising to note the additional information gained after comparison even with stereoscopic plates. The lack of improvement in many chest conditions can be understood after comparing the two pictures.

The iodide is liberated slowly in the various cavities mentioned. It is stated by Forestier that as a rule the greater proportion of the iodine is excreted in the urine by the third day. However, it is still present even in normal subjects after one or two months in various amounts. We have found it at the end of 21, 28, and 32 days in a few patients, although others seem to absorb it more readily. The normal subjects seem to absorb the oil sooner than pathological cases, although this has not always been the rule. For this reason it has become our practice to examine all cases before a second injection has been made. This is not done because of any great danger but there might be a difference in interpretation of the area to be examined if it did not fill properly.

It has been found that the iodine is liberated by the alkaline carbonates of the saliva and intestinal secretions. The gastric secretions have no effect on the oil, and therefore, if any appreciable quantity has reached the stomach, it should be recovered by lavage before acute iodism occurs. In one case, in a child, when we feared that this might occur, vomiting was induced. So far we have not had any acute symptoms appear. Fluoroscopic examination will control this danger so easily that it has been routine to glance at the stomach in all cases after injection. The patient should also be warned to expectorate all secretions for a few days, and to refrain from swallowing any oil left in the throat after injection. Idiosyncrasies to iodine are said not to be a contraindication unless they are very pronounced.

## TECHNIC OF INJECTION

There are four methods available for injection of lipiodol. The laryngoscopic and bronchoscopic methods demand a special apparatus, and a person trained in the use of it. It is comparatively easy in the hands of one who is familiar with the necessary technic, but for the internist it is not always possible to have either the instrument or the training. I appreciate, however, that there may be certain cases that are better adapted to these methods, and I think that with children especially this is the technic of choice. In the cases of the two children I have done, it was very tiresome work to get cooperation, although I realize that I was very fortunate in having patients who were not nervous and who quickly lost their fright of me and the instruments. In these cases it seems that Jackson's laryngoscope is the best apparatus to use.

The third method is the cricothyroid method, and seems to be the least desirable of all, especially in adults. Here the oil is injected into the trachea between the cricoid and thyroid cartilages with a straight or curved needle. Local anesthesia is first necessary. There is a possibility of two dangers in this method. Forestier has suggested the possibility of infection in the surrounding tissues following the withdrawal of the needle from the trachea; and secondly, local subcutaneous emphysema has occurred when the oil was injected into the surrounding tissue. I must admit that I know nothing about this method.

The last, or supraglottic method, seems to be the best suited to the internist. In this technic, a local anesthetic of 10 per cent cocaine is used. In some very nervous individuals a hypodermic of one-sixth grain of morphine and a hundredth of atropine before beginning the anesthesia will give a better result.

In some cases, especially with those who have had treatments of the larynx, an anesthetic may not be necessary. Swab the throat, base of tongue, soft palate, and pharynx two or three times with the cocaine solution. After a few minutes, spray the lower portion of the pharynx, using a spray with a curved nozzle in order to reach the glottis and larynx if possible. After a few minutes, repeat the procedure, telling the patient to hold the tongue forward with a piece of gauze, in order to keep the tongue from slipping back into the throat. Instruct the patient early in the technic to be used, and allow him to become familiar with the various steps. It is surprising to see how well the larynx can be anesthetized in this way. Continue until the patient states that he feels a lump in his throat. Much emphasis must be laid on anesthetizing the soft palate and the back of the pharynx as well as the larynx, since it is necessary to remove both the gag and the cough reflexes. After five or ten minutes, with the tongue held in place, the mirror and curved cannula can be inserted into the back of the throat, and the oil watched as it enters the larynx.

The transglottic method is a modification of the supraglottic technic. Here the cannula is inserted through the glottis into the trachea. This requires more extensive anesthesia, giving 1 to 3 cubic centimeters of warm cocaine directly into the larynx with a catheter or curved cannula.

As a rule, 20 cubic centimeters of the warmed oil is injected, but 40 to 50 cubic centimeters may be necessary to fill the area to be studied, especially if large cavities are present. Apparently there is little danger in this amount, but it is apt to obscure the field with superimposed shadows if only a small area is to be examined.

During the injection with oil the patient should be directed to breathe naturally. If he desires to cough, usually a deep inhalation will control it. Any attempt to swallow during this time loses the field on the mirror, and generally means that the operator has not directed the cannula properly, the oil not entering the larynx. Physical examination of the chest after injection will demonstrate rales until the oil is entirely absorbed.

### POSITION OF THE PATIENT

In planning the injection, the position of the patient must be considered. The oil follows the bronchial tree generally through gravitation. The explosive action of coughing, however, at times forces the oil in various other areas. If the lower lobes are to be examined, the patient sits directly in front of the operator, inclining to the side to be injected. In the upright position, of course, most of the material will follow the right bronchus, but some will always be found in the left side as well. However, if both areas are not to be studied, incline the patient to the side to be filled. When the middle portions of the lungs are to be injected, the patient should be half reclining, and in case the apices are to be filled, the patient should lie nearly flat and be turned to the side in question. In the latter case it is better to have a tilted table to be used immediately after the injection, or at least to allow the head and corresponding arm to hang over the end of the couch in order to get the best possible results. In this case one can visualize only one side at a time.

### PRECAUTIONS AND CONTRADICTIONS

There are a few precautions to observe whichever method is used. The patient should always be watched for a few days, having a complete physical examination before injection. The injection should not be done if a high

fever is present. Examination of the sputum, general laboratory work, and X-ray plates should always be completed first in order to arrive at a diagnosis and determine the extent of chest involvement. Severe bronchial irritation with considerable cough should be watched with a great deal of care. A few cases of edema of the upper respiratory passages have been reported, but none have been fatal. Any ulceration or severe infection of the larynx should be a contraindication until the general and local condition of the patient is known. An injection should not be attempted for a prolonged period following hemorrhage of any great amount. Active tuberculosis with a high fever is a definite contraindication as well as any acute lung consolidation with a large amount of expectoration. Naturally any extensive septic condition should not be studied at that time.

### RADIOGRAPHIC TECNIC

The X-ray plates should be taken as soon after injection as possible. This is necessary in order to get a picture of the true condition before the explosive action of coughing has forced the oil into the terminal alveoli, when the superimposed shadows may obscure the bronchial tree. It seems best, especially if the upper lobes are to be examined, to have the injection made on the radiological table. If the patient is allowed to sit up or stand, the areas may drain before the exposure is made. In all cases an anteroposterior and oblique plate should be made, and in special cases a lateral plate may give additional information. At times a horizontal plate will be of great help in studying the chest. The plates need more contrast than ordinary films, and as a rule the Bucky-Potter diaphragm is an aid in getting good results.

### RESULTS IN NORMAL SUBJECTS

It must not be forgotten what the oil is intended to demonstrate and what is to be accomplished by the injection. The bronchial tree and any draining cavities are the areas to be filled. By the injection, areas in the parenchyma outside the tree can be better studied, but these areas can not be visualized by the opaque media. Any obstruction along the course of the tree can be localized, and the position of the trachea, bronchi, and other structures can be demonstrated.

In normal subjects the trachea, bronchi, and lower branches of the bronchioles are definitely seen. The relation of the trachea to the aorta and esophagus is usually shown. The upper and larger passages are only outlined by the oil, but the smaller branches are usually filled, unless not enough material has been used at the time of injection. Bronchial secretions, if greatly increased, may obstruct the flow of oil into the smaller passages. At times the acini are defined, but as a rule the superimposed shadows do not allow study of these very small compartments when they are normal in size.

### PATHOLOGICAL CONDITIONS

Any obstruction along the course of the trachea from compression in or outside of the upper respiratory tract is easily demonstrated, especially when lateral and oblique plates have been made. This allows study of the mediastinum and demonstrates any pressure masses that may be present.

The use of lipiodol plates instead of ordinary X-ray films in the localization of opaque foreign bodies is not necessary unless the body has been imbedded in the lung for a long time. Here it will help to decide whether it is in the bronchial or lung tissue and whether a lung abscess has developed. With trans-

parent foreign bodies the injection should give a great deal of information. It can be used for localization, and also will help in studying the surrounding tissue. Care must be taken not to inject too much oil, so as to mask the surrounding field.

The greatest help is found in the visualization of bronchial dilatations, especially when they are too early to be demonstrated by ordinary radiographic plates. This is especially true in hilus lesions and in left-sided dilatations when the area to be studied is behind the heart. The areas usually appear like small clusters of grapes, but may be cylindrical, fingerlike, or branching, depending upon the amount of involvement. If there are abnormal bronchial secretions present at the time, the tree may not be filled, and for that reason all suspected cases of bronchiectasis should receive postural drainage before injection. As stated above, this must not be confused with the condition normally present after coughing, and when not enough of the oil has been injected.

As we follow the tree into the lung tissue, the most important fact to be determined is draining lung cavities and abscesses. This is where the chest surgeon finds such great help in both diagnosis and prognosis. The position of the open cavities in the lung parenchyma and its close relationship for drainage through the pleura can be ascertained. Abscesses not draining into the bronchial tree may show very little, but study of the parenchyma will still reveal a great deal of information. Tumor masses, such as primary or metastatic growths in parenchymal tissue, can be demonstrated at times by pressure exerted over apparent nonfilling areas. Deviation of the trachea and bronchi by mediastinal pressure can be observed. Fistulæ and their communication with the bronchi and pleura are best studied in this way. There is a possibility that emphysema, if extensive, may be plated at times.

The relationship of the lung tissue to the pleura can also be determined. Thickened pleura and dense adhesions from previous disease, with deviation of the trachea and bronchi, may not allow proper study of the lung parenchyma. The relationship of old cavities, when the lung has been contracted by scar tissue and possibly by calcified and thickened pleura, is revealed by injection. Many times persistent and prolonged bronchial secretions may have made us suspicious of bronchiectasis, but the diagnosis now can be definitely determined. This is especially true of nonactive tuberculosis and cavity formation in the upper lobe, with associated bronchiectasis below.

The frequent task of differentiating between localized pneumothorax and possible lung cavities can be more easily accomplished. The uncertainty of the so-called annular shadow should now be removed.

As mentioned above, the chest surgeon should find a great deal of help in deciding the operative procedure to be followed. The question of partial or complete thoracoplasties can be decided. The result obtained can be definitely determined. It is interesting to see how few of the cavities are entirely collapsed by even this new method of treatment if followed by injection. The results of therapeutic collapse of the lung for tuberculosis cavities and extensive bronchiectasis can be watched.

It has been stated by some observers that lipiodol seems to have some therapeutic qualities. There seems to be some antiseptic property to low-grade bacterial lung infections. A great deal of improvement has been noted in patients with bronchiectasis, and patients have reported the loss of the foul odor and decreases in the amount of sputum. Healing of chronic fistulæ has been noted by some observers. It seems of little value in the treatment of tuberculous cavities. Lung abscesses have at times healed more rapidly after injection. The permanent results in bronchiectasis can not be determined at

this early date, but the psychological effects with the decrease of cough and foul sputum must be a haven of rest for these unfortunate individuals. The treatment of asthma and chronic bronchitis has been tried with varying improvement. At the present time we have two patients with asthma under this routine. Both were cases of very long standing in which all allergy tests proved negative and in which all possible foci were investigated. It is too early to make a definite statement as to cure, since psychology may enter into the patient's apparent improvement, just as other methods have done in the past.

In therapeutic treatment smaller amounts of oil should be used than in diagnostic work. As a rule, 5 to 10 cubic centimeters, injected frequently, depend ng upon the rate of absorption, gives the best results. Different areas of the lung should be injected each time.

### CONCLUSIONS

1. Injection of iodized oil into the bronchial tree can be done by various methods, none of which causes any irritation and damage to the mucous membrane.
2. The supraglottic method has proved capable of showing any areas demanding study in this small ser.es. No bad effects have been noted, and acute iodism has not occurred.
3. The entire bronchial tree can be followed by repeated injection and all normal and abnormal pathological cavities draining into the system can be filled.
4. The great advantage of this method of study over ordinary X-ray films is demonstrated in visual:zing areas around the hilus, behind the heart, and beneath diseased pleura.
5. The results in collapse of the lung by thoracoplasty and therapeutic pneumothorax can be determined.
6. Annular shadows can be differentiated.
7. The therapeutic action of iodized oil in some chronic pulmonary disease offers a new hope for improvement in these patients.
8. This new medium may open the entire field of therapeutics in pulmonary lesions and prove the vehicle for rapid advance in the near future.

## END RESULTS OF CHRONIC CHOLECYSTITIS

Edward L. Young, jr., has studied the records of all of the cases of disease of the biliary tract treated at the Massachusetts General Hospital up to 1925, in which the diagnosis of chronic cholecystitis was made, and has reported his findings in the New England Journal of Medicine of May 24, 1928.

There were 300 cases studied and end results were ascertained in 115.

The summary of Young's findings follows:

> The end results of 115 cases of chronic cholecystitis have been reviewed. Sixty-three per cent were cured, 15 per cent were not cured, and 22 per cent were relieved of their main symptoms.

The chief cause of failure was mistaken diagnosis, 25 per cent of the cases having duodenal ulcer instead of cholecystitis. The more indefinite the symptoms and uncertain the diagnosis before operation, the greater the chance of failure.

There was no single bit of evidence which seemed definite enough as revealed at operation to tell whether or not the gall bladder was the cause of trouble other than gross change in the gall bladder itself. The removal of a slightly thickened, adherent gall bladder did not cure in every case.

The presence of a "sentinel gland" did not necessarily point toward gall-bladder disease.

In conclusion it seems to me that the only justification for operation on the biliary tract should be well-established clinical and laboratory evidence that the gall bladder is at fault; and that having made that diagnosis, it should be removed in the absence of other demonstrable pathology regardless of whether or not it seems diseased to the examining hand.

## PELLAGRA AND BLACKTONGUE

Goldberger, Wheeler, Lillie, and Rogers, of the United States Public Health Service, have published several papers in which they have presented evidence to prove that blacktongue and pellagra are identical. In Public Health Reports, June 8, 1928, they have a very interesting and valuable paper in which they give the results of their study of 16 foodstuffs with reference to their blacktongue-preventive action.

The foodstuffs studied were maize, wheat, wheat germ, cowpea, soy bean, milk, butter, cod-liver oil, cottonseed oil, beef muscle, pork liver, canned salmon, egg yolk, tomato, carrot, and rutabaga.

Eleven of these substances have been studied as to their preventive action in both pellagra and blacktongue, and the authors have found that their potency against pellagra is similar to that against blacktongue. Those which contain a large amount of pellagra preventive contain a large amount of blacktongue preventive, and vice versa.

The authors consider this similarity—when combined with evidence which they have previously presented as to the clinical resemblance of blacktongue in the dog to pellagra in man, the production of blacktongue in dog by feeding pellagra-producing diets, and the action of yeast in preventing both conditions—as making it very probable, if not certain, that the two conditions are identical.

Of the substances studied, wheat germ and beef muscle are good preventives of both pellagra and blacktongue. Pork liver, salmon, and egg yolk contain the blacktongue preventive in good quantity, but their effectiveness against pellagra has not been determined. It is believed, however, they will be found to contain the pellagra-preventive substance as well. Experiments to determine this will be undertaken.

### MÉNIÈRE'S DISEASE

Archives of Surgery, June, 1928, contains a paper by Walter E. Dandy, of the Surgical Department of Johns Hopkins Hospital and University, on Ménière's disease. The writer concerns himself chiefly with the diagnosis of the condition and a method of treatment for it. Only the summary and conclusions of Dandy's paper will be given here:

1. Intracranial section of the affected eighth nerve is suggested as a cure for Ménière's disease. This operation has been performed on nine patients, none of whom has had a subsequent attack. The lapsed time since operation varies from three months to three and one-half years.
2. The operation should be attended by no mortality and with no after effects, since the patients are practically deaf in the affected ear before operation.
3. Although the series of cases is small, the results suggested that section of the acoustic nerve should stop Ménière's attacks just as absolutely as intracranial section of the glossopharyngeal nerve or of the sensory root of the trigeminus stops the attacks of tic douloureux in these two nerves.
4. The symptoms and signs of Ménière's disease are analyzed. The dizziness of Ménière's and pseudo-Ménière's diseases are compared with that of other known lesions—tumors, inflammations, and aneurysms—in the cerebellum and brain stem.
5. There appear to be reasons to doubt that the cause of Ménière's disease is primary in the semicircular canals. A primary lesion of the acoustic nerve seems a more probable primary source of the attacks.

### ISCHAEMIA

A case in the English courts which has attracted much attention among medical men and which has been reported in the British Medical Journal on several occasions is that of Tyndall *v.* Alcock. A young girl fell and hurt her left elbow. The arm was not examined and splinted at once, but the patient was placed in an automobile and taken a distance of 10 miles to be examined by Doctor Alcock. Apparently everything was done that any careful physician could have done, but it soon became evident that the circulation in the hand was impaired and ischaemic paralysis soon followed. Doctor Alcock was found guilty of negligence and was ordered to pay damages amounting to approximately $10,000.

Under the heading, "Some comments on the case of Tyndall *v.* Alcock," E. W. Hey Groves, Professor of Surgery in the University of Bristol, writes of this case in the British Medical Journal of May 12, 1928. As to the justice of the findings he says:

"* * * I venture to say there never was and never will be, a fracture case which was treated with greater care and solicitude than that of Phyllis Tyndall by Doctor Alcock * * *.

The second striking fact is the way in which a fracture case and the reading of an X-ray film lend themselves to misinterpretation by a jury * * *.

Later, he says:

> The nature of the damage to the arm was very difficult to explain fairly. It is true that the muscle or muscle fibers affected by ischaemic paralysis are permanently lost, and this was represented as though the whole forearm was permanently and totally paralyzed. In reality it is only certain groups of muscles which are affected, and usually some fibers of even these escape, so that, as Sir Robert Jones has shown, ischaemic contracture is capable of great amelioration by patient treatment, and the hand becomes ultimately quite useful in a limited degree. Similarly the fibrous ankylosis of the elbow is a condition susceptible of improvement. But in this case it was suggested that the left arm was permanently useless, and that the child, who was represented as a potential musical genius, had had her career wrecked.

The most interesting part of the writer's comments deals with the cause of ischaemic contracture. In the case under discussion he considers that ischaemia could not have been avoided.

It is generally considered that ischaemic contracture is primarily due to damage to the blood vessels and soft tissues. In this case the damage might have occurred at the time of the accident and been aggravated by the transportation before first aid was applied. In any injury to the elbow where there is effusion and swelling, acute flexion of the elbow will exert a constricting effect upon the blood vessels. This may readily be carried to the point where the radial pulse ceases. For this reason it is a dangerous practice to flex an injured elbow joint, and, where this is done, close watch must be kept on the circulation.

According to Hey Groves, when a case of fracture of the lower end of the humerus is seen some hours after the accident, and there is much swelling present, it is best to leave the arm alone and simply support it on a pillow until the swelling subsides. This usually means that reduction will have to be accomplished by open operation, but the writer considers this relatively simple.

That ischaemia is not due to a lack of alignment of the bones is shown by the fact that if ischaemic paralysis has already developed it is not relieved by placing the bones in proper position.

This case, besides affording the writer an opportunity for a discussion of an interesting subject, illustrates the danger that confronts all physicians who handle fracture cases, when, in spite of every care, something goes wrong.

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## TRANSMISSION OF DENGUE FEVER

In 1926 Siler, Hall, and Hitchens published the results of their experimental work on dengue, from which they concluded that the dengue virus must remain in the Aedes for more than 10 days before the mosquito becomes capable of infecting man.

Recently Paul A. Schule has carried on further work, using 16 soldiers at Corregidor for subjects. The results of his work are published in the American Journal of Tropical Medicine, May, 1928.

Schule found that some of his volunteers became infected with dengue when bitten by mosquitoes eight days after the mosquitoes had their infectious feed.

The conclusions reached by Schule are as follows:

1. Seven men proved to be susceptible to dengue fever were bitten by *Aedes aegyti* at varying intervals of time after the mosquitoes had taken the virus by feeding on a known experimental case of the disease.
2. Dengue fever was not transmitted by interrupted feeding.
3. Dengue fever was not transmitted when the interval between the infectious feed and the subsequent biting was 2 days, 3, 4, or 6 days.
4. Dengue fever was transmitted when the interval between the infectious feed and the subsequent biting was 8 days, 10 days, or more.

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### ORAL ADMINISTRATION OF EMULSIFIED FORM OF TETRAIODOPHENOLPHTHALEIN IN CHOLECYSTOGRAPHY

Sproull reported in the American Journal of Röntgenology and Radium Therapy, March, 1927, satisfactory results from the oral administration of plain tetraiodophenolphthalein without capsules, mixed with cold, cooked breakfast cereal, without fats. He noted no great increase in nausea and was convinced of better and more uniform visualization of the gall bladder.

Possibly inspired by Sproull's report, several manufacturers have recently placed on the market emulsified preparations of tetraiodophenolphthalein for oral administration in fruit juice or water, without capsules. It is claimed for these preparations that there is a marked diminution of nausea and unpleasant reaction, that they are palatable, that they are administered in a single dose, and they are stable if kept sealed.

Considerable dissatisfaction has resulted from the oral administration of gall-bladder dyes in specially prepared capsules, due to the frequent failure of the capsules to dissolve. Any method or preparation that offers hope of better absorption of the dye and lessened discomfort to the patient is most welcome. That the new emulsified form of tetraiodophenolphthalein may offer some of the advantages claimed is indicated in the following quotation from a report of the use of the emulsified preparation in six cases at the Brooklyn Naval Hospital; the observations were made by Lieut. Commander W. A. Fort, Medical Corps, United States Navy.

Keraphen * * * offered as a substitute for Kerasol capsules, has been administered to six patients during the past week with the following results:

(*a*) No complaint of nausea in any case.

(*b*) Patients report preparation is pleasant to taste.

(*c*) Visualization of the gall bladder appears superior to that obtained with the capsule preparation.

(*d*) Sufficient dye remains in the colon to serve as a check on proper ingestion.

Keraphen is a proprietary product and is probably an emulsified form of tetraiodophenolphthalein, as it is administered in the same manner and reacts the same as known emulsified preparations.

### DENTAL INFECTIONS

Under this title Weston A. Price, D. D. S., presents in Radiology, May, 1928, a most interesting discussion of the grave dangers accompanying many of the dental infections, and the limitations of X-ray examinations as definite positive or negative diagnostic evidence.

Undoubtedly many dentists have proved cases of severe dental infections with apparently no evidence in the X-ray films. This Doctor Price attributes, in many instances, to failure to recognize, or properly interpret, the evidence present in the film, and which may be only faintly outlined.

Teeth with a large area of absorption at the apices present such striking evidence of dental infection that the extent of absorption in this area may, unfortunately, become the criterion by which the degree of dental infection is determined. Doctor Price presents considerable evidence in support of his belief that an area of bone "condensation," or sclerosis, and a change in the appearance of the alveolar tissue, especially narrowing of the intratrabecular spaces, has diagnostic importance equal to absorption. Especially does he attach importance to this Röntgen evidence of pathological changes in those cases with symptoms of systemic infection.

### THE ROCKEFELLER FOUNDATION—1927

A review of the activities of the Rockefeller Foundation for 1927 has been issued by President George E. Vincent. It gives, in brief, a summary of the activities of this great organization and, particularly, of its activities in the interest of medical science.

It is of special interest at this time to learn that, in spite of the turbulence and turmoil that have been so prevalent in China during 1927, the Rockefeller Foundation has been able to maintain its high standards of medical teaching in the Peking Union Medical College. During the current year there have been enrolled 78 undergraduate medical students and 21 pupil nurses, while in 1926–27, 70 doctors carried on advanced work at the college.

Increasing numbers of Chinese are being appointed to positions of responsibility on the staff of the college, although it remains the

policy of the institution to keep foreign teachers in the leading positions. In 1927–28 there were 106 staff members, of whom 71 were Chinese.

It was while he was carrying on investigations under the Rockefeller Foundation into the cause, transmission, and pathology of yellow fever that another martyr to science met his death. Dr. Adrian Stokes, professor of pathology at Guy's Hospital Medical School, working at Lagos, Nigeria, developed yellow fever and died on the fourth day of the disease. He did not die, however, until he had accomplished much. One of the most important findings of the commission of which he was a member was that certain Indian monkeys, *Macacus rhesus*, were susceptible to the virus of yellow fever and reacted to it as do humans. Thus, a large step forward in the problem of yellow fever was made.

The Foundation has been working on malaria control since 1916, but, even now, has no uniformly successful method of combating the disease to offer. All methods must be used and each locality must be studied to determine which method is best suited.

Hookworm disease has been studied in many parts of the world and entire communities have been practically rid of this scourge.

Aid has been given to medical schools in widely scattered countries, scientific journals have been supported, and health services have been aided, especially in connection with the Mississippi flood.

In all, $11,223,124 was spent by the Foundation in 1927 in furthering medical knowledge and in spreading its benefits throughout the world.

Since the publication of this review another member of the Rockefeller staff in Africa has fallen victim to yellow fever. Dr. Hideyo Noguchi contracted the disease while attempting to solve the problems connected with its study. Even while seriously ill himself he directed his fellow workers in their efforts to produce the disease in monkeys, and it was his blood that was first successfully injected.

In the death of Noguchi, which occurred May 21, 1928, medicine has suffered an irreparable loss.

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## INTER-STATE POST GRADUATE MEDICAL ASSOCIATION

The Annual Assembly of the Inter-State Post Graduate Medical Association of North America will be held in Atlanta, Ga., October 15–19, 1928.

An unusually fine program has been arranged which will provide much of interest for workers in all branches of medicine and surgery.

Clinics will be held and papers read by many of the leading physicians and surgeons of the United States, Canada, and the British Isles.

A cordial invitation to attend the assembly has been extended to all naval medical officers by the association.

# BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

THE EDITOR, UNITED STATES NAVAL MEDICAL BULLETIN,
*Bureau of Medicine and Surgery, Navy Department, Washington, D. C.*
(For review.)

NELSON-LOOSE-LEAF LIVING SURGERY, prepared under the direction of an advisory board comprising the leading surgeons in the profession. *Editor in chief, Allen O. Whipple, M. D., Professor of Surgery, College of Physicians and Surgeons, Columbia University; Director of Surgical Service, Presbyterian Hospital, New York City. Associate editor, Fordyce B. St. John, M. D. Professor of Surgery, College of Physicians and Surgeons, Columbia University, New York City.* Volumes V and VI. Thomas Nelson & Sons, New York, 1928.

The authors of the important branches of surgery covered by these two volumes have continued the policy set forth in the previous volumnes—of presenting their subjects in an exceptionally clear and interesting manner. The illustrations are particularly well chosen, and are a distinct asset to the various articles.

Volume V covers surgery of the abdominal organs and the peritoneum, while Volume VI takes up the important subject of urology. The authors are outstanding men in their profession, and have presented their subjects in a manner which justifies their selection as contributing authors to this work.

These volumes embrace subjects which are important to naval medical officers, and especially to those doing active surgery. One of the features of this work is the style in which the subjects are taken up. Diagnosis and pathology are thoroughly considered, as are also anamolies, unusual conditions, etc. Treatment is, of course, featured and operative measures exceptionally well presented.

Naval surgeons who have access to the Nelson Loose-Leaf Living Surgery will find Volumes V and VI particularly valuable.

DIAGNOSIS OF DISEASE by *Hobart Amory Hare, M. D., LL. D., Professor of Thereapeutics and Diagnosis, Jefferson Medical College of Philadelphia; Physician to the Jefferson Medical College Hospital, etc.* Ninth edition. W. B. Saunders Co., Phildelphia, 1928.

Of the triad of books from the pen of this worthy writer on medicine, this work, now in its ninth edition, while the least in size, is

perhaps the most important, for it deals with the determination or diagnosis of what is wrong with our patient so we may prescribe for him and cure him of his disease. The skill with which the practitioner uses the methods and material described in this little book is the true measure of his ability as a physician. Our modern medicine depends on accurate diagnosis founded on a framework of interrelated symptoms built at the bedside and braced, so to speak, by the laboratory tests of the technician. It is this approach to the subject that the writer has used. The symptoms are discussed first and their use in the framework of diagnosis is shown later. A very complete index of 56 pages with cross reference gives much quick information.

DISEASES OF THE SKIN, by *Richard L. Sutton, M. D., LL. D., F. R. S. (Edin.), Professor of Diseases of the Skin, University of Kansas School of Medicine, Assistant Surgeon, United States Navy (ret.).* Seventh edition. The C. V Mosby Co., St. Louis, 1928.

That there is sufficient demand to require a seventh edition in less than two years after the sixth publication is an indication of the reception accorded this text book by the medical profession. General practitioners, and among them may be included naval medical officers, when called upon to treat skin diseases will find invaluable aid to diagnosis in the large number of splendid illustrations and the concise and simple descriptions. The latest developments in cutaneous therapy are clearly discussed and those agents known to be reliable and practicable are recommended in treatment. If there is to be a single book on dermatology in one's library, this book will fill the niche.

THE EXAMINATION OF PATIENTS by *Nellis B. Foster, M. D., Associate Physician to the New York Hospital, Associate Professor of Medicine at Cornell University College of Medicine.* W. B. Saunders & Co., Philadelphia, 1928.

The first edition of this book is too well known to need description in these columns. In the second edition Doctor Foster has added differential diagnosis to the material in the first volume and has given us a book which is proportionately increased in value. The subject matter is arranged for ready reference and offers a quick and concise résumé of the modern opinion on the topic. Here is an opportunity for the busy physician to brush the cobwebs from the corners and for the younger man to glean pertinent facts for the successful practice of his profession. The discussion of acute abdominal disease, cardiac hypertrophy and hypertension, and other subjects too numerous to mention, give the book its real value.

CARDIAC ARRHYTHMIAS, by *Irving R. Roth, M. D., Assistant in Medicine; Chief Children's Cardiac Clinic, Mt. Sinai Hospital; Instructor in Post Graduate Studies on Diseases of the Circulatory System conducted by Columbia University at Mt. Sinai Hospital, New York.* Paul B. Hoeber, Inc., New York. 1928. Price, $7.50.

Until recently the " irregular heart " covered a group of cardiac arrhythmias that could not be differentiated into definite types. If the clinician is unable to differentiate the heart irregularity, it immediately falls into the motley group of cardiac arrhythmias. This book is so well written and illustrated with diagrams and graphs that any medical man can at least obtain a fair idea of what constitutes the different forms of arrhythmias.

The first part of the book gives a short, comprehensive review of the anatomy and physiology of the normal heart beat. By studying the normal phenomena described in this part of the book the reader is better able to appreciate the alterations constituting the irregular heart which follow.

The second part of the book deals with the arrhythmias, which are divided into five general groups, each of which is further divided into subgroups. The five main groups give an excellent description of sinus arrhythmias, auriculo-ventricular heart block, extrasystolic arrhythmias (premature beat), paroxysmal tachycardia, auricular flutter and auricular fibrillation, and combined arrhythmias. The author has shown his knowledge of the subject by giving an explanation of the mechanism, clinical features, and conditions that may induce the abnormal beat in each type.

It is impossible to do this book justice in a short book review. It it an excellent text on the subject. The book will be received with enthusiasm by the medical profession and Doctor Roth should feel that he has contributed something different, for it is original throughout.

CLINICAL MEDICINE, by *Oscar W. Bethea, M. D., Ph. G., F. C. S., F. A. C. P. Professor of Therapeutics, Tulane Graduate School of Medicine; Professor of Clinical Therapeutics, Tulane School of Medicine.* W. B. Saunders Co., Philadelphia, 1928.

This is a textbook on the practice of medicine in which about 100 of the more common diseases are discussed. The author has tried to give the practitioner and student a comprehensive idea of how to diagnose and treat diseases in the home. It is well written.

The author is brief in his description, in some parts almost to an outline form. The book is practically made up of the author's lectures given in the past few years to the post-graduate and undergraduate students at Tulane University School of Medicine.

LOBAR PNEUMONIA, by *L. R. Santee, M. D., F. A. C. R., F. A. C. P., Associate Professor of Radiology, St. Louis University Medical School; Radiologist to the University Group of Hospitals; Chief City Radiologist to St. Louis City Hospitals, etc.* Paul B. Hoeber (Inc.), New York, 1928. Price, $3.

Beginning with the epidemic of influenza in 1918, Doctor Santee has collected radiographs of several thousands of cases of pneumonia. He has used this material to write a most interesting and instructive book on lobar pneumonia which is interesting to the clincian for the information it gives on the development of the various types of pneumonia, and particularly for the early diagnosis of pneumonia in the atypical cases. The frank lobar type is usually a simple thing, but the pneumonias of slow development give us many an hour of thought. Doctor Santee's book is very instructive. The serial radiographs showing the stages of development and resolution are very clear. The pictures are worth studying. A good index makes the book valuable for ready reference.

CLINICAL ASPECTS OF THE ELECTROCARDIOGRAM, A MANUAL FOR PHYSICIANS AND STUDENTS, by *Harold E. B. Pardee, M. D., Assistant Professor of Clinical Medicine, Cornell University Medical School.* Second edition. Paul B. Hoeber (Inc.), New York, 1928. Price, $5.50.

The first edition of Doctor Pardee's book was printed in 1924. This, the second edition, is completely revised and enlarged. The important acquisition of knowledge since the publication of the first volume is presented in this book.

The author gives a complete description of all phases of the subject, including the theoretical and clinical application of the electrocardiograph. He is thorough in his discussion of graphs of the normal and abnormal hearts. The adoption of a new terminology to express the variations of the Q. R. S. group, which Einthoven attributed to hypertrophy of the right or the left heart, is an important change.

Several new models of the string galvanometer have appeared in the past few years. The radio amplifier tube is used in an electrocardiograph put out by one manufacturer. The mechanical features and operation of these instruments are mentioned.

This book is well bound, easy to read, and contains 60 illustrations and a well-prepared bibliography. It is an excellent text for the student and guide for the heart specialist.

HAY FEVER AND ASTHMA, by *Ray M. Balyeat, M. A., M. D., F. A. C. P., Instructor in Medicine and Lecturer on Allergic Diseases in the University of Oklahoma Medical School; Member of the American Association for the Study of Allergy; Director of the Balyeat Hay-Fever and Asthma Clinic, Oklahoma City, etc.* Second edition, revised and enlarged. F. A. Davis Co., Philadelphia, 1928. Price, $3.50.

The first edition of this work was published in 1926. That a second edition is so soon required speaks well for it. It is a book of

great value to the physician, but is written in nontechnical language so that it can also be understood by the layman.

In the second edition some sections which were condensed in the first edition have been amplified. This is particularly true of the section in which wind-borne pollens are discussed.

Differences in pollen in various parts of the country are discussed, and the importance of these differences when desensitization is attempted is recognized. Pollen extracts for treatment should be made locally, according to the author.

That orris powder is a frequent offender is clearly brought out.

This book should be in the library of every physician who is called upon to treat sufferers from asthma and hay fever.

DENTAL INFECTION AND SYSTEMIC DISEASE, by *Russel L. Haden, M. A., M. D., Professor of Experimental Medicine, University of Kansas School of Medicine, Kansas City, Kansas.* With a foreword by *Dr. Edward C. Rosenow.* Lea & Febiger, Philadelphia. 1928.

A careful and conservative account of studies in which the author sought to assign dental disease to its proper place as a causative factor in generalized infections, avoiding overemphasis and underestimation.

The more important conclusions may be briefly stated.

Pyorrhea and pus pockets are much less important than periapical infection as sources of systemic disease of focal origin.

The incidence of chronic dental foci of infection is very high among those suffering from chronic disease.

The extraction of an infected tooth does not necessarily eliminate the alveolar infection.

The high incidence of infection around retained root fragments seems a valid argument for their removal unless there are definite contraindications for any operative procedure.

Too often physicians depend entirely on radiographic findings. Much information is gained by tests for vitality, sensitiveness to heat and cold, percussion, and transillumination.

Arthritis is the commonest systemic manifestation of focal infection in man.

An excellent book, worthy of careful reading.

THE ULTRA-VIOLET RAYS, THEIR ACTION ON INTERNAL AND NERVOUS DISEASES AND USE IN PREVENTING LOSS OF COLOR AND FALLING OF THE HAIR, by *Arnold Lorand, M. D. (Vienna).* F. A. Davis Co., Philadelphia, Pa. 1928. Price, $2.50.

As the subtitle indicates, this book is more of a clinical and philosophical treatise than a textbook on the properties and uses of the ultra-violet rays.

Part I of the book is a more or less rambling discussion of the action of ultra-violet rays on general medical conditions, mixed with

generalizations upon the part that endocrine disturbances bear in these conditions. There are considerable repetition and references to other works of the author.

Parts II and III are mainly a discussion of the causes that underlie the falling out and graying of the hair. The part played by the ultra-violet rays in the prevention of falling or graying of the hair is not very clearly shown by the author and could be made more easily readable by the elimination of repetitions and condensation of the subject matter.

This book will be interesting perhaps to those who are greatly disturbed over falling or gray hair, but for the practitioner who wants to add an ultra-violet ray outfit to his office equipment, there is not much in the book that will help him.

Muscle Function, by *Wilhelmine G. Wright.* Paul B. Hoeber (Inc.), New York, 1928. Price, $3.50.

This little volume, dedicated to the late Dr. Robert W. Lovett, is written by his physical assistant, Miss Wright. In her gymnasium work she collected the material on which this book is based and she presents a text which is complete and enlightening. It might well be called a "Functional Anatomy of Muscles," for there is a description of the groups of muscles involved in the various muscular functions. For the orthopedic surgeon there is presented a ready reference to use, as well as a list of muscles involved in each muscular action. The book should be useful to the physical therapeutist in the development of the weakened muscles following paralysis of the infantile or traumatic type.

Studies in the Psychology of Sex. Volume VII, Eonism and other supplementary studies, by *Havelock Ellis.* F. A. Davis Co., Philadelphia, 1928. Price, $5.

This is the final volume of Havelock Ellis's "Studies," which have been so widely known since the first edition was published in 1900. It treats of various departures from the normal in sexual psychology, such as eonism, the pleasure derived from wearing the clothing of the opposite sex; undinism, the gratification obtained by some from the sight and sound of running water; and kleptolagnia, the desire to steal because of the emotions aroused by theft of certain articles. In addition, the mechanism of sexual deviation is lucidly discussed, and dream synthesis, as opposed to the analysis of dreams, is extensively described.

The final chapters on the history of marriage are of especial interest and consist largely of a critical review of Westermarck's classical work, "The History of Human Marriage." Ellis evidently

has great admiration for the ideas advanced in this country by Judge Lindsey, concerning "companionate marriage," as a noviciate prior to permanent marriage. "Innocence"—where ignorance is really meant—is fast disappearing among both sexes of the younger generation, to the great benefit of all, according to the author.

The student of abnormal psychology will find much to interest him in this volume.

YARNS OF A KENTUCKY ADMIRAL, by *Hugh Rodman, Rear Admiral, United States Navy.* The Bobbs-Merrill Co., Indianapolis, 1928.

A naval medical officer, like other physicians, sometimes wishes to read other books than those treating of medical subjects. No book known to the reviewer will give keener pleasure in the reading than this one by Admiral Rodman. It is not just a collection of yarns such as those who have the privilege of knowing the author would expect him to spin. It is this and more, as in its pages is found much of the history the Navy has made in the past fifty years, and in the making of which the author played no inconsiderable part.

The Battle of Manila Bay and the service of our battleships with the Grand Fleet in the World War are entertainingly described.

In his more serious moments Admiral Rodman has made a plea for the maintenance of an adequate navy in order that our country may not suffer the fate that has befallen other nations which have possessed navies that were almost good enough—but not quite.

No naval officer, medical or other, will want to miss reading this book, and it will be a good thing for our country if it becomes widely read by the public.

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# THE DIVISION OF PREVENTIVE MEDICINE

Commander M. A. Stuart, Medical Corps, United States Navy, in charge

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Notes on Preventive Medicine for Medical Officers, United States Navy

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## FINAL REPORT OF THE COMMITTEE, CHEMICAL SECTION, NATIONAL SAFETY COUNCIL, ON SPRAY COATING (ABRIDGED)

It is only within the past 10 years that possible health hazards in the use of the spray gun have been brought to the attention of industrialists. In Dr. Alice Hamilton's monograph on The Hygiene of the Painters' Trade, published in 1913,[1] there is no mention of spray coating. The first mention of this subject in the literature is found in a paper by Dr. R. P. Albaugh, of Ohio, in 1915.[2] Wade Wright, in 1917,[3] in a statistical table showing the cases of lead poisoning diagnosed during the first year of his industrial clinic at Boston, includes a spray painter.

Five years later N. C. Sharpe published the first really extensive study of the process of spray coating from the standpoint of the hazard of lead poisoning at that time.[4] In this study a paint was made up in which the pigment consisted entirely of white lead, this being 60 per cent of the whole mixture. The liquid portion consisted mainly of linseed oil and turpentine in approximately equal parts. This mixture was diluted with benzine to the proper consistency for spray painting. Air pressure was kept between 35 and 55 pounds per square inch, and the spray was directed against a vertical wall. The experiments were done in a large room with a low ceiling, so there was a tendency for the fumes to roll back toward the operator. No direct draft for fume removal was in operation. Some specimens of air were collected by being drawn through suction cylinders contain-

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[1] Bulletin 120, U. S. Bureau of Labor Statistics, May, 1913.

[2] Albaugh, R. P.: A fatal case of slow poisoning in the person of a young man employed as a sprayer in a varnishing department, Ohio Public Health Journal, Vol. VI, No. 5, November, 1915, p. 512; also, The dangers connected with the spray method of finishing and decorating, American Journal of Public Health, Vol. VII, No. 3, March, 1917, p. 279.

[3] Wright, Wade: An Industrial Clinic, Monthly Labor Review, U. S. Bureau of Labor Statistics, December, 1917.

[4] Sharpe, N. C.: Report on an investigation to determine the hazard to the health of operators using the spraying machine for painting: The risk of lead poisoning. Journal of Industrial Hygiene, April, 1922, vol. 3, p. 378.

ing water or dilute acid, the air being broken up by the finely perforated bulb on the suction tube. In the case of other specimens Duckering's method was used. Samples of air were taken at various positions likely to be occupied by the nose and mouth of the spray painter, 300 liters of air being used for each estimation. In order to study the distribution of the spray, porcelain plates varying in surface area from 12 to 50 square centimeters were exposed horizontally in different locations for half-hour periods. In estimating the samples for lead they were treated as if the lead was in organic combination.

During the three-day experiment in spraying the wall the operator worked from four to five hours daily. The urine for the 24 hours following showed the presence of 0.3 milligram of lead. The plates exposed for half-hour periods indicated that with lead paints sprayed with the apparatus used at that time lead was deposited 11 feet to the right of the operator and 3 feet behind the operator.

In certain other studies the collecting apparatus was taken to a factory where small objects (1 to 2 square feet) were spray painted in a cabinet provided with excellent suction. No lead was recovered from the air samples, although plates exposed at various points indicated that at certain positions in the neighborhood of the sprayer lead was deposited.

Various types of masks were tested in order to determine the degree of protection afforded the spray painter. In each case a duplicate air sample without protection was taken as a control. It was found in this study that fine wire-gauze masks afforded no protection whatever. A mask of gauze and cotton made as thick as possible without causing uncomfortable or constrained breathing reduced the lead present in 10 cubic meters of air from 90 to 10 milligrams. A mask of gauze, cotton, wool, and charcoal reduced the lead from 104.2 to 3.33 milligrams. This mask was so uncomfortable, however, that no workman would endure it, and if worn comfortably it was found to be useless on account of entrance of air from the side. Masks of comfortable breathing thickness of gauze and cotton wool, moistened with a 5 per cent solution of sodium sulphide, reduced the amount of lead present from 232 to 12.4 milligrams per 10 cubic meters of air. A similar mask, but dry; that is, without sodium sulphide solution, permitted 11.7 milligrams per 10 cubic meters to pass through, whereas a moistened mask in the same test permitted but 5.8 milligrams to pass.

The author calls attention to the risk of poisoning from the inhalation of fumes of volatile substances used in paint, but concludes that there is no danger from lead poisoning in spraying small objects properly placed in an exhaust cabinet provided with efficient

suction. On the other hand, he concludes that his experiments show that when lead is a constituent of a paint used in spraying walls inside a building there is real danger of lead absorption. In exterior painting he feels that there would probably be less risk from poisoning since the painter could take advantage of the prevailing air currents.

In 1924 Doctor Hamilton pointed out that the danger of the painter from lead poisoning had recently been increased by the very general adoption of the spray gun for painting all sorts of factory goods, large as well as small objects being painted in this manner, and recently the interiors of buildings.[5] She states that "experiments by the United States Bureau of Mines show that it is possible to construct a gas mask which will filter out oily droplets without becoming clogged, but it remains to be seen whether men will consent to work eight hours a day in a gas mask."

After the appointment of an advisory committee and the holding of public hearings, regulations governing spray coating were adopted in 1924 (revised in 1925) by the Industrial Commission of Wisconsin. In the spraying of buildings, ships, and structures these regulations fixed a maximum distance between the spray gun and the object to be treated, provided that respirators or other devices approved by the industrial commission must be worn, and that exposed parts of the body should be covered by a nondrying oil, grease, or cream. In the spray coating of other objects booths must be provided with exhaust ventilation, although the extent of such ventilation is only indicated in a foot note as follows:

> In some instances an average flow of 200 cubic feet per minute per square foot of booth space area was found none too much for effective protection, and in other cases as low as 80 cubic feet per minute was found equally effective.

The next important step was taken in Pennsylvania,[6] where an exhaustive study of the whole problem was initiated in the spring of 1925 under the State Department of Labor and Industry. This investigation—the first really comprehensive one which had been conducted anywhere—was directed by Prof. H. F. Smyth, of the Laboratory of Hygiene of the University of Pennsylvania, in conjunction with Dr. Elizabeth E. Bricker, of the Department of Labor and Industry. Thirty-two different industrial groups comprising 233 plants using the spray gun in production were visited and studied, many of them applying the spray to furniture or to small metal

[5] Hamilton, Alice: The prevalence and distribution of industrial lead poisoning. Journal of the American Medical Association, Aug. 23, 1924, vol. 83, No. 8, p. 583.

[6] Smyth, Henry Field: Hazards of spray coating processes investigated. The Nation's Health, May, 1927, vol. 9, No. 5, p. 24.

Smyth, Henry Field: Spray coating processes. American Journal of Public Health, May, 1927, vol. 17, No. 5, p. 440.

objects. Ninety-one analyses were made for benzol, 22 for lead, 26 for dust, 168 air-velocity determinations were made. In all, 383 physical examinations were made and 43 specimens of urine were analyzed for lead. In addition to these field investigations, Doctor Smythe and his associates conducted special studies on benzol concentration and exhaust ventilation in an experimental booth specially set up for the purpose in the Laboratory of Hygiene of the University of Pennsylvania.

The Pennsylvania study made it clear that there are three major health hazards which may be involved in the use of the spray gun for interior work under various specific circumstances. Where paints and enamels contain an important proportion of lead, plumbism may result; where benzol thinners are used in connection with paints or lacquers sprayed upon the interior surfaces of structures or upon manufactured articles, there is danger of benzol poisoning; vitreous enamel used in making bathtubs and similar vitreous ware frequently contribute to the atmosphere sufficient finely divided silica to create a silicosis hazard. No clearly marked clinical cases of poisoning were revealed in the course of the Pennsylvania studies, but an appreciable proportion of workers exposed to benzol showed the disturbed blood picture characteristic of early benzol poisoning and it appeared that the benzol content of lacquers and similar finishes is highly variable and uncertain and that, even when not originally present, benzol is frequently added in the form of cheap lacquer thinners. Exposure to benzol was therefore at that time much more common than was generally realized. Doctor Smyth and his associates found that both benzol and lead were often present in large amounts in the air breathed by the industrial sprayer and that of the 127 lacquer sprayers examined 5+ per cent showed white-blood cell counts indicative of benzol poisoning and 39+ per cent gave a disturbed blood picture. The Pennsylvania study also revealed that 18 per cent of the men engaged in paint spraying showed stippled cells or polychromatophilia (the property of being stainable with certain stains). In the Pennsylvania investigation of eight spray painters engaged in building or structural painting, none were found to have lead poisoning.

## II. Initiation of the Present Investigation

Recognizing the importance of an authoritative examination and study of the health hazards of spray coating by an unbiased body, and as yet unaware of the Pennsylvania study, the National Safety Council at its Cleveland Safety Congress in 1925 created a special steering committee to organize an intensive study of the problem and appointed Mr. A. L. Watson as chairman. The steering com-

mittee in turn appointed for this purpose a spray-coating committee of 23 members representing Federal and State bureaus, universities, national health organizations, insurance companies, organized labor, and manufacturers of materials and equipment used in spray coating, with Prof. C.-E. A. Winslow, of Yale University, as chairman. The committee met in New York for organization on March 5, 1926, and elected Dr. Leonard Greenburg, of the United Public Health Service, secretary. A tentative program of study was drawn up and a request made for an appropriation of $10,000 to finance it.

The National Safety Council appropriated the necessary funds and at a second meeting of the committee held on June 4, 1926, it was decided to invite Dr. H. F. Smyth and his associates, who had recently completed their study in Pennsylvania, to undertake the actual conduct of the new investigation. At the same time the United States Bureau of Mines was asked to conduct certain special studies of the efficiency of respirators which it was felt were necessary to supplement existing knowledge of this subject.

The committee was exceedingly fortunate in thus securing the services of Doctor Smyth and his colleagues, who were even then in the midst of similar studies and were thus able to begin active work without the delay incident to coping with a new problem. Associated with Doctor Smyth were H. F. Smyth, jr., and Dr. E. F. Pike, who conducted field and chemical studies. Blood counts were made by Dr. Miriam Izard, J. R. VanMeter, and Miss A. T. Marston. Some blood counts, as well as urine analyses, were made by Doctor Haluska, of Detroit.

## III. Scope of the Investigation

The use of the spray gun had penetrated so many industries and was employed for such a wide variety of purposes that it was obvious to the committee that the investigation must be confined to the study of the more significant hazards. Even therein, with the time and money at its disposal, it could not hope to accomplish a searching investigation which would accurately measure the degree of hazard or establish any considerable volume of reliable information. The course that seemed best was to select a locality which promised a reasonable field in which conditions could be studied intensively rather than broadly. It was recognized that this might not yield results that were typical of the industries studied or typical of the spray-painting occupation as a whole. It would constitute, however, a forward move which, with the results of the Pennsylvania study, could be expected to cast additional light on an obscure problem for which industry was demanding a constructive solution.

The three outstanding health hazards arose obviously from the use of benzol, lead, and silica, the latter not the siliceous pigments

ground in linseed oil used sometimes as a constituent of paints but the free silica that might be present in vitreous enamels. The primary objective, therefore, was the detection of benzol poisoning, plumbism, and silicosis and their prevention. Such cases were to be sought principally among sprayers of lacquer, leaded undercoats, and vitreous enamels. The first two of these pointed directly to the field of automobile finishing, as this might be expected to yield satisfactory information on both benzol and lead; vitreous-enamel spraying should yield information on both lead and silica. The selection of these industries, therefore, was economical and also desirable, in view of the fact that in Pennsylvania it had been impossible to study large-scale automobile body finishing or individuals who had been subjected to long exposure in vitreous enameling processes.

In making this selection (or reaching its final conclusions) the committee could not be guided in any way by statistical information on occupational-disease occurrence among spray operators, because nothing reliable of the kind existed. It is generally conceded that many cases of chronic benzol poisoning, plumbism, and silicosis are undetected, pass for other diseases, or, at least, are not reported as occupational diseases. Furthermore, no information is available on the corresponding exposure to the hazards in question, so that their relative severity can not be ascertained in industry as a whole or in any branch of industry or in any specific occupation. We can not say, for example, on the basis of statistical knowledge, whether brush painters are more prone to plumbism than undercoat sprayers, or whether there is a relatively higher death rate from silicosis in granite cutters than in enamel sprayers. In this matter the committee at once recognized the futility of attempting any statistical exploration; general judgment could be the only guide.

The activities of Doctor Smyth's staff began in fact on June 7, and, after assembling equipment and conducting certain preliminary studies, they proceeded to Detroit and Toledo, where it had been decided that the most favorable field could be found. Through the courtesy of Dr. Henry F. Vaughan, commissioner of health of Detroit, laboratory facilities of the most excellent character were generously placed at their disposal. During the period spent by the field staff in Detroit tests were made in 4 automobile-body plants, in 2 automobile factories, and in 3 vitreous enameling plants. Employees of three contracting painters were also studied. In Toledo study was made of a large automobile plant, a vitreous-enamel plant, and a plant making spray-painting equipment. The employees of six contracting painters were also examined. Enameling plants in Mansfield and in Cleveland were also visited and studied.

Throughout the study the effort was made to observe conditions existing in the industries which were being examined, to determine

the degree of atmospheric pollution in the air breathed by the operator, and to correlate as far as possible these engineering and chemical findings with the actual condition of the operatives as revealed by careful clinical examination and by refined blood tests and examinations of body discharges. Altogether 29 different plants (or groups of workers) were studied. Eighty-six air tests were made for benzol, 27 for lead, and 33 for silica. A total of 354 physical examinations were made, including 349 blood tests.

### IV. Spray Paint Constituents

A paint is a mixture of pigment and vehicle (liquid portion) with which additional thinning liquid may sometimes be used. The following is a summary of the substances usually encountered in various types of paints:

*Interior paints.*—For interior walls and ceilings of dwelling houses, hotels, factories, etc., lead-free prepared paints are quite widely used in spray-painting work. They contain as a rule the following solid ingredients: Lithopone, zinc oxide, titanium oxide pigments, calcium carbonate, barium sulphate, china clay, and other siliceous earth pigments.

The liquid materials used in spray paints for interior surfaces, which are applied possibly to the greatest extent, are vegetable drying oils, chiefly linseed oil and chinawood oils.

The thinners almost universally used with these interior spray paints are mineral spirits (a high-boiling-point distillate from petroleum) and, to a very minor extent, turpentine. The main use for turpentine in paints is where the paint is mixed by hand rather than in prepared form.

*Exterior paints.*—For general exterior painting work upon dwellings and other structures where white and light tints are desired, the pigments most commonly used are basic carbonate white lead, basic sulphate white lead, zinc oxide, leaded zinc oxide, titanium oxide pigments, lithopone, china clay, and other siliceous earth pigments. The tinting colors used in these white paints, where a tinted paint is desired, are usually in very minor proportions and consist of such tinting colors as Prussian blue, chrome green, carbon black, chrome yellow, iron oxides, ochre, sienna, etc.

Paints for exterior work contain usually not over 10 per cent by weight of volatile materials, the balance being solid pigments and liquid drying oils. Many of these paints contain not over 6 or 7 per cent by weight of volatile materials, and of this percentage in many cases the volatile is entirely mineral spirits, although in some cases from 2 to 7 per cent may be turpentine.

In finishing railway cars, such as freight cars, coal carriers, etc., and structural steel the paints employed are almost invariably made

with carbon black or mineral earth pigments such as mineral brown, ground in raw linseed oil or in heat-bodied oils and varnishes. As a rule, the volatile portion of such paints will run from 10 to 20 per cent by weight. In this volatile portion in most instances there is no turpentine, the volatile portion almost invariably consisting of straight mineral spirits. No benzol or other aromatic hydrocarbons are employed in such paints.

*Lead.*—Lead is also used as a primer on structural steel.

*Lacquers.*—Nitrocellulose lacquers are made with soluble nitrated cotton, gums such as dammar, ester gum, etc., solvents and plasticizers. The solvents almost universally employed are amyl acetate, butyl acetate, ethyl acetate, butyl propionate, acetone, ethyl alcohol, and butyl alcohol. While benzol was at one time quite widely used in lacquers, its use has now been discontinued by practically every manufacturer of lacquer because of its recognized health hazards. It has been replaced with toluol. Wherever ethyl alcohol is used it is denatured and may contain up to 5 per cent of wood alcohol or 0.5 per cent benzol in accordance with the requirements of the United States Government denaturing formulae. Finished lacquers in which denatured ethyl alcohol is used, however, probably never contain as much as 1 per cent of wood alcohol. Some other types of solvents are being experimented with in a limited way and in small amounts. These include turpentine solvents, cyclohexanol, and diacetone alcohol. The total amount of volatile material in lacquers probably ranges from 40 to 70 per cent by weight. Nitrocellulose enamels contain in addition to the above ingredients a great variety of pigments. For certain colors it is necessary to use lead compounds, particularly lead chromate, which may be present in an amount up to 10 per cent by weight.

As additional thinning mediums, toluol and xylol are used almost exclusively in high-grade lacquers. According to the findings of the benzol committee they are relatively harmless.

The so-called plasticizing mediums used in lacquers are very high-boiling-point materials that do not evaporate rapidly and which largely remain in the film. These are such substances as tri-cresyl phosphate, dibutyl phthalate, diamyl phthalate, diethyl phthalate, etc.

## V. BENZOL POISONING AS A SPRAY-COATING HAZARD

No attempt will be made to review the extensive literature of benzol poisoning since the reader who desires to go more deeply into the subject will find it very fully presented in the report of the committee on benzol of the National Safety Council issued a year ago.[7]

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[7] Final report of the committee on benzol, chemical, and rubber sections, National Safety Council, May, 1926.

In general, it is only necessary to recall that benzol is a highly toxic substance causing a complex of symptoms which may be summarized as follows: (*a*) General systemic disturbance as evidenced by headache, dizziness, weakness, loss of appetite, and loss of weight; (*b*) pallor, shown by blood examination to be due to true anemia; (*c*) marked reduction in white blood cells (revealed, of course, only by microscopical examination); (*d*) bleeding from nose, gums, vagina, and bowels, with the development of purplish spots caused by small hemorrhages within the tissues; (*e*) sore and spongy gums and burning of eyes and throat; (*f*) shortness of breath and tightness of chest; (*g*) sometimes abdominal pains, nausea, and vomiting; (*h*) sometimes slight tremors, visual disturbances, and abnormal sensations, rarely convulsions and delirium; (*i*) rarely rashes and skin eruptions.

Benzol poisoning may be detected in its very early stages by a decrease in the number of white cells present in the blood and according to the findings of the committee on benzol a white cell count below 5,625 per cubic millimeter of blood may be considered a reasonably clear index of latent benzol poisoning. Injuries of this sort to the blood-forming organs were found in the studies of the committee on benzol to be associated with even very low concentrations of benzol in the atmosphere (100 p. p. m.) while Legge states that 550 p. p. m. is likely to be associated with definite clinical poisoning.[8]

The committee on benzol concluded that masks and respirators depending on the filtration principle should not be relied upon to protect the workers against ordinary routine exposure to benzol fumes, since such devices can not be made efficient without making them too uncomfortable to be worn continuously. It urged that, wherever benzol is used as a solvent or vehicle under conditions which almost of necessity permit more or less evaporation into the atmosphere, effective exhaust ventilation should be provided together with monthly medical examination including blood tests to detect incipient poisoning. It finally concluded that the serious attention of manufacturers now using benzol should be directed to the substitution of some less harmful solvent for so dangerous a substance.

### VI. Results of Benzol Poisoning Investigation

In 2 of the 7 plants studied the lacquer was thought to contain little or no benzol, in 1 the men had been on strike and had thus been free from recent exposure, in 1 plant the composition of the material was variable, and in 3 benzol was definitely present (1.5, 5, and 9 per cent, respectively). The booths or tunnels in which the spraying

[8] Legge, T. M.: Chronic Benzol Poisoning. Jour. Indust. Hyg., March, 1920, I, No. II, p. 539.

was performed were all provided with systems of local exhaust ventilation but the average air velocities in all but one plant (in which the average velocity was 147 feet per minute) were generally low, ranging from 45 to 73 linear feet per minute.

Determinations of benzol in the air were made in only 5 of the plants studied with average results varying from 375 to 1,880 parts of benzol per million. Individual test results, however, varied widely and were not closely correlated with the benzol content of the lacquer, though they did indicate that the benzol hazard in this industry is a very real one.

The following comparison of the low exposure plants (the two using lacquers supposed to be nearly free from benzol and the one from which the workers had recently been absent on account of a strike) with the other four plants which, for the sake of comparison were termed "high-exposure plants" brings out some very suggestive differences. First, the men in the high-exposure plants reported more than twice as many subjective complaints as the men in the low-exposure plants (particularly constipation, dizziness, and dyspnea), and the proportion of these complaints reported showed generally an increase with length of service. Second, the men in the high-exposure plants showed a larger proportion of low red cell counts—17 per cent with less than 4,000,000 red cells, as compared with 7 per cent for the low-exposure plants; while the white cell count, the most significant index of incipient benzol poisoning, gave an even more striking contrast. Taking the benzol committee limit of 5,625 white cells per cubic millimeter as a dividing line, only 1 man out of 69 in the low-exposure plants fell below standard while in the high-exposure plants 19 out of 91 men examined gave a disturbed blood picture. Here, as in the case of subjective symptoms, Doctor Smyth's data show a striking increase in disturbed blood pictures with increased length of service. Finally, the analysis of the combined blood picture and subjective symptoms for individual workers shows that out of the 69 men in the low-exposure plants only 1 gave a pictutre suggestive of a diagnosis of benzol poisoning while there were 7 such men out of 91 subjects employed in the high-exposure plants.

From these results it seems very clear to the committee that the spraying of benzol lacquers with the spray gun constitutes a real health hazard under the conditions found by Doctor Smyth.

### VII. Lead Poisoning as a Spray Coating Hazard

The whole subject of industrial lead poisoning has been so admirably reviewed by Aub, Fairhall, Minot, and Reznikoff[9] that it is

[9] Lead Poisoning. Aub, J. C., Fairhall, L. T., Minot, A. S., and Reznikoff, Paul. Medicine Monographs, Vol. VII, 1920.

unnecessary to discuss the general subject. It need only be recalled that the ingestion of lead may be detected by analyses of feces and the absorption of lead by analyses of urine. Lead poisoning in its incipient stage is indicated by a characteristic stippling of the red cells of the blood.

In the present investigation Doctor Smyth studied 170 men, including 97 men working in six different automobile or automobile-body plants spraying paints and undercoats, 38 house painters using the spray gun on inside or outside work, and 35 men applying vitreous enamel to castings. The materials used by the undercoat sprayers contained 10 to 19 per cent of lead. The paint used by the indoor painters contained less than 1 per cent and that used by the outdoor sprayers 19 per cent. In the vitreous-enamel plants the soluble lead varied from 0.4 to 20 per cent.

In the booths used for spraying paints and undercoats the average exhaust velocity produced at the working face by the local ventilation provided was again low (averaging 28 to 75 linear feet per minute), except in one plant where an average velocity of 160 feet was recorded. Conditions in the vitreous-enamel plants were somewhat better, with velocities averaging between 0 and 212 feet. The amount of lead determined in the air was low in the case of two undercoat plants and in the case of the indoor house painters, but was high in the three other undercoat plants (32 to 164 milligrams lead per cubic meter of air).

Since our resources did not permit of both procedures, it was arranged to have chemical examinations made of feces rather than of urine. Urine studies would, of course, have been more significant of actual lead absorption, but lead in the feces is at least indicative of the ingestion of the poison, and it was desired to secure data comparable with those obtained by the United States Public Health Service in its study of tetraethyl lead. Of the group of 65 spray painters examined 17 per cent showed more than 0.03 milligram lead per gram of feces as against none in the normal persons and 34 per cent in those workers exposed to a highly intensive lead hazard, in the Public Health Service study.[10] Our group includes two structural painters, one of whom showed over 0.03 milligram of lead per gram of feces.

Of the 170 workers subjected to medical examination 19 per cent complained of digestive disturbances, 10 per cent of loss of weight, 9 per cent of constipation, 8 per cent of loss of appetite, and 3 per cent of gastric pain, while 5 per cent showed the characteristic blue line on the gums. Of the 39 structural painters examined 4 com-

[10] The Use of Tetraethyl Lead Gasoline in Its Relation to Public Health. Bulletin No. 163, Treasury Dept., Washington, D. C., 1926.

plained of digestive disturbances, 3 of loss of weight, 4 of constipation, 1 of loss of appetite, 2 of gastric pain, and only 1 showed a blue line on the gums. Owing to the small total of men in this class the figures are given as numbers of men, rather than per cent of the total.

Blood tests failed to show any extensive prevalence of anemia but counts of stippled cells made on a selected group yielded striking results, 7 out of 16 men giving a count of over 100 stippled cells per 100,000 total cells as against only 1 out of 15 lacquer sprayers examined as a control. This result, like the data for lead in feces, would tend to place interior spray coating with lead paints in the class of hazardous industrial occupations. Doctor Smyth's data indicate that, out of 97 undercoat sprayers, 6 individuals gave a complex of signs and symptoms suggestive of incipient lead poisoning. Among 38 house painters there were 3 cases of this kind, while 37 sprayers of vitreous enamel containing lead gave 5 more.

Again, as in the case of benzol, we may conclude that the lead poisoning hazard in spray coating as at present conducted in the industrial plants examined is a distinctly significant one.

### VIII. Silicosis as a Spray Coating Hazard

The spraying of vitreous enamels in the manufacture of sanitary ware, refrigerator linings, stove parts, milk tanks, etc., may involve two distinct hazards—that of lead poisoning when the substance sprayed contains lead and that of silicosis when finely suspended silica dust is present. The latter problem will be found fully discussed in its more general application in a monograph by Greenburg.[11]

The present study covered 35 workers (of whom 2 were women) in 6 groups employed in spraying vitreous enamel on castings and 26 workers (of whom 19 were women) in 4 groups spraying vitreous enamel on sheet metal. The enamels sprayed on castings included a substantial proportion of lead (4–26 per cent total lead, 0.4–20 per cent soluble lead) with a relatively low percentage of silica (21–37 per cent). On the other hand, the vitreous enamels sprayed on sheet metal contain little or no lead and a higher proportion of silica (43–47 per cent). The sprayers on castings have already been included in our earlier discussion in the groups exposed to the lead hazard; both groups of vitreous-enamel sprays (61 in all) furnish material for an estimate of the silicosis hazard.

According to the experience of English students of industrial hygiene marked success in protecting the health of the workers has been attained in pottery manufacture by the use of a low solubility lead glaze, a bisilicate of lead yielding less than 5 per cent of soluble

[11] Greenburg, Leonard: Studies on the Industrial Dust Problem. Public Health Reports, Feb. 13, 1925, pp. 291–309; Apr. 17, 1925, pp. 765–766; and July 31, 1925, pp. 1591–1603.

lead. This type of fritted lead silicate, if it is possible to use it in spray coating, should also avoid the danger of silicosis. We have no information as to whether such materials are in the market in this country but that the practice is not general is indicated by Doctor Smyth's analyses which show that in four out of five instances most of the lead present was in soluble form. The possibility of preparing a vitreous enamel so compounded as to contain no important proportion of either free lead or free silica should be given very careful study.

Measurements of air velocity showed that in the booths where vitreous enamel was sprayed on castings the exhaust was reasonably effective with velocities averaging 123 to 212 feet per minute. In the booths where sheet metal was treated the apparatus was much less efficient, giving average velocities varying from values too low to be measureable up to 125 feet per minute.

Doctor Smyth's dust counts at the working face of these spray coating booths were highly significant. The one plant equipped with a really adequate system of ventilation giving an air velocity averaging 212 linear feet per minute yielded an average dust count of 400,000 particles per cubic foot. Two other plants with exhaust velocities of between 123 and 130 feet, respectively, gave average dust counts of between 5,000,000 and 24,000,000 particles per cubic foot. The plant with an exhaust system so poor as to give no measurable velocity showed an average of 445,000,000 particles per cubic foot.

It seems clear to us from these observations that an exhaust velocity of 130 linear feet per minute may be insufficient to properly protect the vitreous-enamel sprayer from dangerous exposure to silica dust; but that an exhaust velocity of over 200 linear feet proved adequate for the purpose in the instance studied.

The physical complaints reported by the sprayers of vitreous enamels were more numerous than in the case of the other groups studied, and this was true not only for the sprayers on sheet metal, who were chiefly women, but also for the male sprayers on castings. It is particularly notable that dizziness was reported by 31 per cent of the sprayers on castings and 27 per cent of the sprayers on sheet metal; loss of weight by 23 per cent of the sprayers on castings and 19 per cent of the sprayers on sheet metal; dyspnea by 17 per cent of the sprayers on castings and 27 per cent of the sprayers on sheet metal.

The most direct measure of the silicosis hazard can, of course, be made by radiographic examination, and readable pictures were obtained for 32 different individuals. Twenty-three of these 32 workers had been employed for less than three years at this type

of work and all of the 23 plates from these workers were negative. Of the 9 workers employed for more than 3 years, on the other hand, two gave a picture interpreted by the expert who read the plates (Dr. H. K. Pancoast) as silicosis, and a third as probably silicosis.

### IX. Protecting Spray Coaters by Local Exhaust Ventilation

Recognizing the very real hazards to which the spray coater may be exposed from benzol, from lead, and from silica dust, it is next essential to consider how he can be protected from such danger.

The first type of protection to which we naturaly turn is that of local exhaust ventilation; and in one instance, that of spraying vitreous enamel upon castings, we have fairly clear evidence of the value of such equipment. In the vitreous-enamel plants with exhaust ventilation amounting to 130 linear feet per minute or less relatively high dust counts were found with suggestive evidence of plumbism. In one plant studied, however, we find a very different picture. Here 14 men were employed in spraying a compound containing 4 per cent of lead and 37 per cent of silica. With an exhaust ventilation varying from 166 to 257 linear feet the dust counts were consistently under 600,000 particles per cubic foot and no case of silicosis was found in a series of X rays covering all the 14 individuals. It would seem probable from these findings that exhaust ventilation of 200 linear feet per minute may adequately protect the worker against the silica hazard in the spraying of vitreous enamel. Further studies may show that exhaust rates lower than 200 linear feet per minute may prove adequate with improved arrangements of booth and spray gun.

As regards lead, if we compare the exhaust ventilation in the various plants spraying lead with the lead content of the air respired by the worker, we find a very high degree of atmospheric pollution (32–164 milligrams lead per cubic meter of air) in three undercoat plants associated with poor exhaust ventilation (28–54 linear feet per minute). There was suggestive evidence of plumbism in a vitreous-enamel plant with an exhaust of 130 feet and in another with an exhaust of 123 feet. On the other hand, in an undercoat plant with an exhaust of 160 feet and in a vitreous-enamel plant with 212 feet no cases were found.

From this evidence it may be concluded that an exhaust velocity of 130 linear feet is probably inadequate for the protection of the spray coater against lead poisoning, though the data are scarcely sufficient to state whether or not an exhaust of 150 feet would or would not in general provide satisfactory protection. Further study may make a more definite standard possible.

For benzol we have even less information. Of seven plants studied six had average exhaust velocities under 75 feet per minute. In one of the six satisfactory benzol determinations were not obtained; the other five had very high benzol concentrations in the air respired by the worker. The seventh plant had an average exhaust of 147 feet, but here again no satisfactory air analyses for benzol were obtained; yet in this plant 4 out of 11 men showed low white counts and 1 a complex of symptoms suggesting benzol poisoning.

In the Pennsylvania studies in experimental booths fitted up at the University of Pennsylvania Doctor Smyth conducted an extensive series of tests on the relation between exhaust ventilation and benzol concentrations in the air when the gun was used to spray various lacquers containing from 0.7 to 9.2 per cent benzol. Full details will be found in the Pennsylvania report, but the main results may be cited as follows:

TABLE I.—*Results of Pennsylvania experiments on relation between exhaust ventilation and benzol concentration in the air*

| Exhaust velocity (feet per minute) | Cumulative percentages of results falling in each concentration group at given exhaust velocities | | | | |
|---|---|---|---|---|---|
| | 0 p. p. m. | Under 50 p. p. m. | Under 100 p. p. m. | Under 150 p. p. m. | Under 200 p. p. m. |
| 0-49 | 25 | 38 | 63 | 75 | 75 |
| 50-99 | 49 | 77 | 90 | 92 | 97 |
| 100-149 | 58 | 77 | 88 | 95 | 98 |
| 150-199 | 57 | 76 | 86 | 95 | 95 |
| 200 plus | 75 | 88 | 100 | | |

It would seem reasonable to conclude from this table that an exhaust velocity of 200 linear feet per minute will offer reasonably effective protection against benzol in the case of booth spraying. It will be noted that this is also the velocity found effective in actual practice in the case of vitreous enamels. We can see no justification for specifying any lower exhaust velocity where benzol is liable to be present, since, according to these data, exhausts between 150 and 199 linear feet give 14 per cent of all observations over 100 p. p. m. of benzol and 5 per cent over 150 p. p. m.—a distinctly hazardous concentration.

### X. Protecting the Worker by Masks or Respirators

The second possibility of protecting the worker against the hazards of spray coating with such materials as lead, benzol, and silica lies in the wearing of a mask or respirator, and this is, of course, the only type of protection which can be employed with certainty in the case of indoor spraying without a booth or equivalent ventilation.

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Masks and respirators are of two distinct types, those which depend on the principle of filtration (with or without chemical absorption) and those which depend on the provision of a supply of pure air by positive pressure.

The problem of the efficiency of the first class of respirators seemed to require detailed experimental study, and we were fortunate in securing for the purpose the cooperation of the United States Bureau of Mines. Through the courtesy of Mr. Scott Turner. director of the bureau, Messrs. S. H. Katz and F. H. Gibson were assigned to this work, the cost of the study being defrayed by the National Safety Council.

A paint containing 100 grams of white-lead paste in 50 cubic centimeters of linseed oil and 25 cubic centimeters of benzol was discharged by a spray gun under a pressure of 20–30 pounds into a chamber, from which air was drawn off at a rate of 1.13 cubic feet per minute, approximately the rate of respiration of a man performing vigorous physical work. In tests for lead the air thus drawn off was passed through the mask or respirator (or the special filtering material studied) and thence to a Cottrell precipitation tube, where the lead passing the filter was precipitated by a high-tension electric current. Comparison of the lead retained by the filtering material with the sum of the filtered and precipitated lead gave the per cent purification effected.

In planning this work it was assumed that for complete protection against lead a filter respirator should be capable of reducing an atmospheric concentration of 200 milligrams lead per cubic meter to one of 0.6 milligrams—a reduction of 99.7 per cent. Only two of the actual respirators tested and one of the special filtering materials tested met such a specification. These devices were a respirator with two filters (each of 10 plies of gauzy tissue paper) plus a charcoal cartridge, and an Army gas mask with 2 cotton wool filters plus 600 cubic centimeters of charcoal. The special filtering material was made up of three layers of chemical filter paper (S. & S. No. 589, black label) which showed a high efficiency. With a respirator and Army gas mask the resistance to air flow at the end of half an hour was between 3.8 and 4.4 inches of water, but in the case of the chemical filter paper it was 44 inches. It is impossible for a man to perform vigorous physical work while wearing a respirator with a resistance of over 2 inches of water, so that our data do not yield much hope of securing complete protection by any filtering device which is not too impervious to be worn with reasonable comfort.

It is evident that as one approaches an effective purification one also approaches an inteferference with respiration which makes it impossible for the device actually to be employed in any approxi-

mately continuous process. Furthermore, it should be remembered that these tests were made with absolutely tight fittings and that in practice the efficiency might be very much lowered by leakage about the junction with the face.

In studying the efficiency of respirators with regard to benzol a similar procedure was employed, except that the amount of benzol remaining in the filtered air was determined by an interferometer calibrated against synthetic mixture of benzol and air.[12] It was assumed that an efficient respirator for use against benzol must be capable of reducing a concentration of 2,000 p. p. m. of benzol to one of 75 p. p. m.—a reduction of 96.25 per cent. The various types of purely mechanical filters, of course, have no effect in restraining benzol vapors; some chemical absorbent is essential for such purpose. Three of the devices studied, the Gardner respirator (with about 5 grams of charcoal granules interspersed in cotton), the Pulmosan respirator containing activated charcoal, and the Army gas mask, promised some degree of effectiveness, but only the latter proved really adequate. The Gardner respirator showed no noticeable decrease in benzol and the Pulmosan cartridge reduced a concentration of 420–1,360 p. p. m. of benzol to 75 p. p. m, for only 19 minutes. The Army gas mask gave an atmosphere of less than 75 p. p. m. for 250 minutes. The Army gas mask is, therefore, effective, but is, of course, altogether too cumbersome and uncomfortable to be worn for any continuous period during work of this sort.

In the case of silica dust it has been suggested that an efficient respirator shoud reduce a dust count of 200,000,000 dust particles per cubic foot to one of 200,000 [13] dust particles per cubic foot, a reduction of 99.9 per cent. None of the filters tested gave such a degree of efficiency, the nearest approach to it being obtained with 16 layers of bleached muslin and with 4 layers of chemical filter paper. In both cases, however, the high resistance made such a respirator impracticable.

The results, therefore, suggest the conclusion, which many members of the committee have reached as a result of practical experience, that respirators of the filter type can not be expected to be highly efficient unless they are so impervious as to interfere very seriously with comfort and efficiency. They are excellent as a protection against occasional brief exposures, but we believe that it is

[12] Katz, S. H., and Bloomfield, J. J.: Gas masks for gasoline and petroleum vapors. Technical Paper 348, Bureau of Mines, 1924.

[13] Winslow, C.-E. A., Greenburg, L., and Angermyer, H. C.: Standards for measuring the efficiency of exhaust systems in polishing shops. Public Health Reports, 1919, vol. 34, p. 427.

General Report of the Miners' Phthisis Prevention Committee. Union of South Africa, 1916. Final Report of the Miners' Phthisis Prevention Committee. Union of South Africa, 1919.

not safe to rely on such respirators for routine use in continuous processes where there is exposure to dangerous materials.

Fortunately there is another type of respirator which is based on a wholly different principle and which can be made both efficient and comfortable. This is the respirator with positive air supply, bathing the face in fresh, pure air and maintaining a constant outflow through the normal leakage spaces. Winslow, Greenburg, and Reeves [14] have found this apparatus immeasurably superior to filter respirators for the protection of sandblasters. In some industries the use of such a device involves serious objections on account of the difficulty of securing positive air pressure, but in spray coating it is quite simple to obtain the air needed from the spray gun itself. Several devices of this kind are already on the market,[15] and Commandant J. S. McKean, of the Mare Island Navy Yard, has improvised one that has been used with marked success.

It is essential that the air supplied to the interior of the respirators should be kept free from oil vapors and other impurities. This may require the interposition of a purifier. It is also, of course, necessary to provide means of reducing the air pressure supplied to the mask.

We conclude that the positive pressure respirator is the type which should be recommended for the general protection of paint sprayers, and are convinced that such a device if properly designed and operated will furnish an adequate and practical safeguard. Many other types of respirators have some value in reducing the lead hazard of workmen on noncontinuous employment in spray painting.

## XI. Medical Supervision of Spray Coaters

Wherever men are employed within buildings, booths, or other indoor or inclosed spaces, in spray coating with materials containing benzol or lead in the form of paints, or silica in the form of vitreous-enamel compounds, whether with or without exhaust ventilation or the use of respirators or masks, provision should be made for systematic routine medical examination for the detection of early symptoms of poisoning or of silicosis. For this purpose, we would suggest the following program:

*Physical examinations.*—(*a*) The health of persons inhaling material being sprayed upon interior surfaces may be injured by lead or benzol in paints or by finely divided siliceous materials in vitreous enamels. In order to protect spray operators from these hazards it is recommended that they be given a physical examination previous to or within one month of employment, in order to determine whether

[14] Public Health Reports, Mar. 5, 1920.

[15] See Appendix II, fig. 1, and Appendix II, fig. 2.

they have any physical defects which might be made worse by their employment and in order to obtain a record of their physical condition for comparison with succeeding examinations.

(*b*) Periodical examinations of persons spraying compounds containing lead or benzol upon interior surfaces should be made at least once every three months, and should include white and red blood cell counts and an estimation of the percentage of hemoglobin and of stippled cells in the case of lead exposure.

(*c*) The periodical examinations of persons spraying vitreous enamel or similar siliceous vitreous materials should be made at least once every year, and should include an X-ray examination of the chest.

(*d*) No person should perform the work of an interior spray-painting operator with paints containing lead or benzol if the results of an examination of his blood show any evidence of a disturbance that would be aggravated by exposure to lead or benzol, or any evidence of lead or benzol absorption indicated by any of the following findings:

1. The presence of 20 stippled cells per 100,000.
2. A distinct evidence of anemia, as shown by hemoglobin under 70 per cent, or red-blood cells under 4,000,000 per cubic millimeter for men and 3,800,000 for women.
3. A total white cell count under 5,600 per cubic millimeter, or a total morphonuclear cell count under 4,000 per cubic millimeter. When a second or succeeding differential count is more than 5 per cent lower in polymorphonuclear cells than the preceding one, the worker may be continued in his work for a period of no longer than three months if he seems to be in good physical condition otherwise. If, at the end of that period, a recount shows the condition to be progressive, he should not be permitted to continue spraying regardless of his physical condition in other respects.

(*e*) No person should spray vitreous enamel or other vitreous siliceous materials if an X-ray examination of his chest shows the presence of fibrosis or active tuberculosis. Any evidence of developing fibrosis at subsequent examinations should call for a change of occupation. Any evidence of progressive lead absorption by such persons, as indicated by the increase of stippled cells as described above, should likewise call for a change of occupation.

Study of the fire and possible explosion hazards introduced by the application of flammable materials by the spray method formed no part of the work assigned to this committee. A few words on the subject, however, may not be amiss in a report dealing primarily with safety.

The existence of such hazards has been recognized for many years. These hazards can be adequately safeguarded by the proper storage and handling of finishing materials, properly designed and located noncombustible spray booths, adequate ventilation and good house-

keeping, the safeguarding of electrical hazards and the elimination of open fires, unprotected flames, and sparking or friction hazards and by proper fire protection. The most important of these safeguards are adequate ventilation and good housekeeping.

The precautions which should be taken are fully set forth in the National Fire Protection Association's pamphlet entitled "Pyroxylin Finishes—Their use and Suggestions for Safeguarding the Attendant Hazards" and the regulations of the National Board of Fire Underwriters for "Paint Spraying and Spray Booths." Copies may be obtained by writing to the National Fire Protection Association, 40 Central Street, Boston, Mass., or to the National Board of Fire Underwriters, 85 John Street, New York City.

### XIII. Elimination of Injurious Materials

If the foregoing conclusions are justified, it is safe in indoor work to spray materials containing appreciable amounts of lead (over 2 per cent), benzol (over 1 per cent), or of free silica, when the worker is protected in one of the two following ways:

(*a*) By local ventilation producing an exhaust of 200 linear feet per minute in the breathing zone of the worker. This standard is not based on sufficient evidence to warrant its formulation as a legal requirement and subsequent study may show that a lower velocity may suffice with improved operating conditions.

(*b*) By an efficient mask of respirator of the positive-pressure type.

In the case of all the three hazards considered there may often be a far simpler way out of the difficulty—to eliminate the substances in question from the materials used for spray coating.

*Free silica.*—The possibility of controlling the hazard of silicosis in vitreous enameling by the use of a properly balanced and completely fritted mixture free from soluble lead or free silica in substantial proportion should be given careful study.

*Benzol.*—In the case of benzol the conclusion seems clear that the presence of this substance in spray paints is entirely unnecessary. We have ourselves noted two plants using lacquer materials containing little or no benzol and entirely avoiding any suspicion of benzol poisoning. That relatively pure materials can be obtained is indicated by the fact that two samples of pure toluol obtained on the open market actually proved to be practically free from benzol. As a matter of fact, we have been informed that many lacquer manufacturers have seen the wisdom of discontinuning the use of benzol and of replacing it with nonpoisonous toluol as the hydrocarbon thinner for nitrocellulose lacquers.

*Lead in interior spray paints.*—In so far as the spraying of interior surfaces with paints is concerned, it would appear that there

is no necessity for using lead base spray paints for such purposes, as other materials are available which are entirely satisfactory in white and many light tints. In booth spraying of automobiles and similar fabricated articles lead base paints could be eliminated in many instances but not entirely in automobile primers containing a moderate percentage of lead, or in the case of certain automobile chromate colors, for which satisfactory substitutes are not yet available. It is suggested that manufacturers experiment to find suitable colors to replace the lead pigments used in automobile undercoats.

*Final conclusion.*—We would then urge as our most important and fundamental recommendation that manufacturers of paints, lacquers, shellacs, varnishes, and vitreous enamels to be used in spray coating should so far as possible eliminate benzol, lead, and free silica from their products, and where this has been done should clearly label such products as containing less then a certain maximum amount of lead or benzol or free silica, as the case may be; and that employers using the spray gun for indoor and booth work should so far as possible insist on obtaining and using only materials so labeled.

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## LEAD POISONING ON BOARD THE U. S. S. "SEATTLE"

By Jacob Stepp, Commander, Medical Corps, United States Navy

The U. S. S. *Pueblo* was assigned as the receiving ship at the navy yard, New York, N. Y., on April 1, 1921, and served in this capacity until September 15, 1927. The U. S. S. *Seattle*, which had been the flagship of the United States Fleet from April 20, 1923, to September 15, 1927, arrived at the New York Navy Yard on August 28, 1927, and replaced the U. S. S. *Pueblo* as the receiving ship on September 15, 1927.

This move involved months of preparation and labor on the part of the officers and men of the U. S. S. *Pueblo* in an extensive chipping and red-leading operation which included all the double bottoms, all bunkers and other inclosed spaces, together with a thorough overhaul of all machinery and auxiliaries by the engineering department preparatory to the decommissioning of the ship on September 28, 1927.

On or about May 1, 1927, while considerable work of this type was in progress, members of the crew who were engaged in the chipping of paint and the application of red lead in inclosed spaces below decks, began to report to the ship's medical officers complaining of symptoms suggestive of lead poisoning.

The writer called the attention of the executive officer and the first lieutenant to these observations, as well as to the instructions contained in article 2565, Manual of the Bureau of Construction and

Repair, 1924, and recommended that these instructions be followed to the letter. This recommendation was promptly approved by the executive officer, who ordered the first lieutenant to have copies of these instructions made in the form of an order and posted upon the various bulletin boards throughout the ship. Copies of this order were also distributed with appropriate explanation to all men engaged in chipping or painting in the double bottoms or other confined spaces, and division officers and petty officers were required to see that this order was properly carried out. In short, the team work and cooperation of all concerned were good.

A copy of this order follows:

Unless great care is taken, persons working with lead in any form are liable to lead poisoning. The dust and fumes of lead and paints containing salts of lead cause more sickness among workers than is caused by any other metal. Nine-tenths of all lead poisoning can be prevented by keeping dust, fumes, and products containing lead from entering the mouth and nose of the worker.

Lead poisoning produces indigestion, colic, chronic diseases of the heart, lungs, and kidneys; causes paralysis, and may cause blindness.

Lead may enter the system—

1. Through the mouth—
   - (a) By being swallowed with food;
   - (b) By being swallowed with saliva if gum is chewed, or tobacco used in any form, or if fingers are put in the mouth;
   - (c) By being licked from the lips and swallowed; and
   - (d) By being breathed in through the mouth.
2. Through the nose—
   - (a) By being inhaled as dust; and
   - (b) By being inhaled as fumes.
3. Through the skin, to a limited degree; occasionally by absorption.

Lead poisoning can be prevented in almost every instance by requiring observance of the following rules:

1. Some type of respiratory mask, while working in compartments containing lead-laden dust, should be worn.

2. A full meal, with plenty of milk, should be eaten before going to work. The presence of food in the stomach helps to prevent lead from getting into the system.

3. Eating or drinking in a compartment containing lead-laden dust must be avoided.

4. Alcohol in any form should be abstained from; it greatly increases the danger and severity of lead poisoning.

5. The hands should always be washed with a brush, and the face with hot water and soap, the mouth rinsed, and the finger nails cleaned immediately after stopping work and before eating.

6. A bath should always be taken after finishing work, followed by a change into clean clothes.

7. The compartment must be kept well ventilated.

8. Smoking or chewing tobacco and chewing gum while at work must be avoided.

9. Gloves should be worn during the process of handling, grinding or mixing of lead paints.

When a workman complains of symptoms suggestive of lead poisoning he should be directed to report to the medical officer for observation. Should the diagnosis be in the affirmative he should be removed from further contact with lead. Briefly, the symptoms of poisoning are loss of appetite, indigestion, constipation, nausea, vomiting, pains in the abdomen (colic), disturbed sleep, dizziness, weakness of the arms, legs, or body, and muscular cramps.

No treatment should be taken except upon competent medical advice. Properly supervised, the administration of 1 grain of calcium sulphid daily, as a prophylactic, appears to have proven of value in preventing poisoning in certain industrial plants. Five grains of sodium hyposulphite daily may be used instead of calcium sulphid.

Other essential information contained in the section entitled "Precautions in painting" of this manual follows:

When about to examine, clean, or paint double bottoms, etc., the following precautionary measures shall be adopted: They shall be opened and well ventilated, a connection being made to a fan system, if possible. This done, the purity of the air shall be tested before entering by burning a candle on the bottom at least five minutes, except in the case of freshly painted compartments and those that have contained fuel oil, gasoline, or other similar gas-generating oils or liquids. Working parties inside shall always maintain communication with some one outside; they shall have with them a lighted candle, except in the case of freshly painted compartments and those that have contained fuel oil, gasoline, or other similar gas-generating oils or liquids, and shall withdraw should it begin to burn dimly. Artificial ventilation shall be maintained while painting or working in freshly painted double bottoms and similar spaces. Naked lights shall not be used in paint or oil rooms or confined spaces that are being painted or that have recently been painted. Naked lights shall not be used in compartments that contain or have contained fuel oil, gasoline, or other similar gas-generating oils or liquids.

All compartments herein prescribed for bituminous compositions or paints must be thoroughly ventilated while coatings or paints are being applied, in order to protect the workmen from obnoxious fumes. When applying lead paints in compartments a provision should be made by compressed air or otherwise to blow out lead particles in order to prevent lead poisoning.

Painters should not use turpentine to clean paints off their hands. This will lead to what is known in the trade as "drop wrist." Oil paints should be removed from the hands with warm water and soap or with linseed oil if necessary. Before handling putty the painter should coat his hands with soapsuds or raw linseed oil. This will prevent the putty from sticking to his hands and will permit easy cleaning.

As a result of these precautions, there was a gradual diminution in the number of men reporting at sick call with symptoms indicative of lead poisoning. But one man, the patient whose sysmptoms first attracted attention to the possibility that lead poisoning was developing in members of the crew, was transferred to the United States Naval Hospital on June 3, 1927. The fact that only one man of the many engaged in working with lead paint developed symptoms severe enough to require treatment in a hospital speaks well for the care and preventive measures taken during the extensive chipping

and red-lead painting operations that were undertaken under summer temperatures and conditions.

When the U. S. S. *Seattle* replaced the U. S. S. *Pueblo* as the receiving ship at New York it was apparent that similar work had also been started in the double bottoms and other compartments of that ship. The medical officer thought that this work had been recently started and that it was a part of an overhaul due to the change in the status of the ship. When members of the crew of the U. S. S. *Seattle* reported for treatment with symptoms suggestive of lead poisoning, however, an investigation was started and it was then established, according to accepted statements of the crew, that they had been using red lead extensively since August 1, 1927, and that apparently no written instructions had previously been given to those in contact with lead paint or posted on the ship's bulletin boards.

When this information was obtained the precautions to be taken in the handling and mixing of paints and in painting, as given in the Manual of the Bureau of Construction and Repair, were posted on the ship's bulletin boards and copies were given to each man engaged in the preparation and application of lead paint, as was done on board the U. S. S. *Pueblo* during the six months of similar work preparatory to placing that ship out of commission.

During October a few men who had some of the symptoms of lead poisoning were treated, but, as their general condition was good, memoranda were sent to their division officers recommending that they be given a change of detail, from work with lead paint in confined spaces to duty in the open air on deck. This change of duty varied from one to two weeks, depending upon the condition of the individual and the symptoms exhibited.

With the increasing knowledge acquired by the crew regarding the symptoms of lead poisoning as a result of the wide publicity given this condition through the instructions given to members of the crew and posted on the bulletin boards, it was natural to believe that on board a ship, with a crew made up largely of recruits, men would be prone to consult their medical officers upon the slightest symptoms of "stomach trouble."

The office records show that from October 20 to November 28, 1927, about 70 men reported at the sick bay with the above condition, stating that they had pains in the abdomen or "cramps." As such complaints are not infrequent, and in view of the publicity given to the symptoms of lead poisoning, they were not regarded seriously. It was not until this became an almost daily occurrence, and especially when several new patients reported at the same time and on successive days, that the condition was brought to the attention of the commanding officer.

It is the policy of the writer at all times to discover some reason for an outbreak of disease before making a diagnosis and prescribing treatment, so that proper preventive measures can be recommended and placed in effect. In this connection the work a man has been performing and the place wherein he has been working are always borne in mind and invariably inspected. Therefore an investigation, started when it was noted that an unusually large number of men were reporting at sick call each morning, showed that all of those affected were working in compartments where dust from the chipping of paint and the fumes of red lead were present. It was also noted that the compartments were poorly ventilated and that electric fans were used instead of portable blowers. In other words, fresh air was not introduced from the outside but the air within the compartment was simply kept in motion by the fans.

On or about October 25, 1927, when it became apparent that symptoms suggestive of lead poisoning were developing among the members of the crew of the U. S. S. *Seattle* who were exposed to lead-paint hazards, the possibility of lead poisoning was reported to the commanding officer and suggestions and recommendations were made with a view of preventing further damage.

Having in mind the printed instructions issued to the crew, it was evident that some factor had been overlooked. The rules, regulations, and laws enacted by State and municipal authorities for the protection of persons employed in contact with lead or lead products seemingly were not sufficient to prevent absorption. If such occupation continues over a long period of time some toxic signs or symptoms usually appear.

In support of this assertion as to the dangers of long-continued exposure to preparations of lead, the following interesting statement from a recent article on chronic lead poisoning from snuff by Dr. J. Uttal, of New York, published in the Journal of the American Medical Association, January 28, 1928, is quoted:

> The continued inhalation of lead in small amounts will lead to chronic poisoning because of the cumulative nature of the poison. It being further stated that a daily dose of 8 to 10 milligrams of lead causes chronic lead poisoning.

This article was written after the finding of cases of lead poisoning among persons using snuff that had been packed in lead containers.

The commanding officer promptly took steps to minimize the danger from the absorption of lead by the exposed persons. Portable ventilating sets of the ¼-horsepower Diehl type, which had been used with excellent results during similar work on board the U. S. S. *Pueblo*, were secured to replace the electric fans. In addition, the division and petty officers were thoroughly instructed in the need of greater care in enforcing the provisions contained in the circular of

instructions. Upon the recommendation of the writer all men working in the double bottoms of the ship were relieved frequently and were not allowed to remain in contact with lead for more than half a day at one time. These measures resulted in the abatement of the outbreak.

In contrast to the experience on board the U. S. S. *Pueblo* where one case of lead poisoning required hospital treatment, 10 members of the crew of the U. S. S. *Seattle* were transferred to the United States Naval Hospital at New York as with "diagnosis undetermined" but with a tentative diagnosis of poisoning by lead. As all of these cases failed to show the characteristic "blue line" at the gum margin, the tentative diagnosis was based entirely upon the general symptoms. Upon further observation, 8 of the 10 cases sent to the hospital proved to be actual cases of lead poisoning.

The medical officers of the U. S. S. *Seattle* are of the opinion that the cases of lead poisoning which developed on board that ship were due to the long period of exposure to lead while the men were engaged in the chipping of paint and the application of red lead during the summer months before the ship became the receiving ship at New York. Also, in the opinion of the writer, there is perhaps more actual danger in the inhalation of the fine dust produced by the pneumatic chipping of old red-leaded surfaces in closed spaces than in the fumes of paint. It is also thought that such work could best be performed by the civilian workmen of the navy yard who are skilled in their respective branches, know the proper way to handle the materials, and are familiar with the rules of safety applied thereto.

According to lead-paint regulations in Great Britain as given in the Journal of the Commonwealth Department of Health, Melbourne, Australia, for July, 1927, and as applied to Australia, the Secretary of State is given powers to make regulations for the protection of persons employed as painters against the danger from lead poisoning. This law became operative on January 1, 1927, and requires that white lead, sulphate of lead, or lead products shall not be used except in paste form or ready-mixed paints; that they shall not be applied in the form of a spray in interior painting; and that no surface painted with lead paint should be rubbed down or scraped by a dry process.

Other noteworthy regulations contained in this law are as follows:

1. (*a*) There shall be provided for the use of persons employed in or in connection with the painting of buildings and liable to come into contact with lead paint a sufficient supply of water, soap, nail brushes, and towels; and at least one bucket or basin for every five persons so employed.

(*b*) Five minutes shall be allowed to each such person for washing before each mealtime and before leaving work.

2. Suitable arrangements shall be made to prevent clothing, put off during working hours, being soiled by lead paint. Where practicable, the accommodation so provided shall be outside any apartment in which painting is being carried on.

3. Where the chief inspector of factories gives notice to an employer that the incidence of lead poisoning among the persons employed by him, in or in connection with the painting of buildings with lead paint is excessive, such employer shall make arrangements for the periodic examination of all persons so employed by him, and for the suspension from such employment of any of such persons whose health is or appears likely to be injuriously affected thereby, in accordance with such conditions as the chief inspector of factories may prescribe.

4. (*a*) The employer shall give to each person employed by him in or in connection with the painting of buildings when he is engaged and subsequently on the first pay day in each year, a copy of the prescribed leaflet containing special health instructions as to the use of paint.

(*b*) A printed copy of these regulations shall be posted in the workshop, paint store, and in any apartment in which the paints are mixed, on all jobs on which more than 12 men are employed in painting operations.

5. Overalls shall be worn during the whole of the working period by every person employed in or in connection with the painting of buildings and liable to come into contact with lead paint, and shall be washed at least once a week.

6. Every person employed in or in connection with the painting of buildings shall deposit his clothing put off during working hours so as to prevent it being soiled by lead paint, and for this purpose shall as far as practicable make use of the accommodation provided in pursuance of regulation 2.

7. Every person employed in or in connection with the painting of buildings and liable to come into contact with lead paint shall carefully clean and wash his hands before each mealtime and before leaving work.

8. Every person employed in or in connection with the painting of buildings and liable to come into contact with lead paint shall present himself at the appointed time for medical examination when so required by regulation 3.

While the above regulation, in contrast to our own, makes no mention of the use of any respiratory mask, the makers of the law may have found them of little use, as seemed to be the experience on board the U. S. S. *Seattle*. At the time the commanding officer's attention was directed to the appearance of lead poisoning among members of the crew, respirators were used by every man working with lead. Subsequent observation showed that men engaged in such work, and knowing the instructions and precautions to be observed, simply would not wear these masks steadily, especially when working in summer temperatures or upon becoming overheated. They can not understand the danger. This failure to appreciate the value of a respirator or mask, in my opinion, is doubtless due to the lack of some visible demonstration, as collapse or death, as occur with gas in chemical warfare. With gas one can see the sudden toxic effects, whereas in lead poisoning the effects are cumulative.

## FIVE CASES OF LEAD POISONING OCCURRING ON BOARD THE U. S. S. "WYOMING" DURING THE YEAR 1926

By W. W. HARGRAVE, Lieutenant Commander, Medical Corps, United States Navy

Following a program of painting, which included an extensive chipping of metal surfaces on board the U. S. S. *Wyoming* during the year 1926, a patient reported at the sick bay on October 26, 1926, while the ship was at the navy yard, League Island, Pa., and presented symptoms suggestive of lead poisoning. The patient was transferred to the naval hospital at this station, where the diagnosis of chronic lead poisoning was established. A large draft of men was transferred from this vessel to the U. S. S. *Arkansas* about November 1, 1926, and about one week later two cases of lead poisoning developed among the men in this draft. Additional cases were admitted on board the U. S. S. *Wyoming* on November 15 and 27, 1926, making a total of 5 cases attributed to the chipping and handling of paint. Practically all of the paint was removed both from the exposed surfaces and those within the ship during the past year, but no cases of lead poisoning developed among the men working in well-ventilated compartments, on the upper decks, or on the side of the ship.

When the diagnosis in the first case was confirmed, preventive measures were recommended and immediately placed in effect. The men were required to wear goggles, gauze masks, and gloves when chipping in double bottoms or poorly ventilated spaces, to wash their hands and faces thoroughly, using soap and warm water, before the noonday meal and after working hours, and were instructed not to eat, smoke, chew gum or tobacco while engaged in the chipping of paint. Talks were given by the medical officer regarding the danger and significance of lead poisoning and any man was relieved from this work when there was the least suspicion of lead poisoning. The men worked in relays in so far as practicable and an endeavor was made to distribute this work among the crew with the view of limiting, as far as possible, the time of exposure for any one man. It is believed that the chief portal of entry for the lead was by inhalation through the nose and mouth. The dust was then swallowed and absorbed. Gauze masks were made and distributed by the medical department daily, and it was striking how quickly they became soiled and discolored from the collection of numerous dust particles. Two of the five men affected had been working in the double bottoms for a period of four weeks, averaging about four hours per day for five days of the week, while the third patient had been working for a period of two weeks. It was noted that other men who worked under the same conditions for longer periods were not affected. The gauze

masks were not used until after the first case developed, and it is quite probable that had this measure been started sooner cases of lead poisoning might have been prevented. In view of the extensive scaling done on this ship, including the outside, upper decks, and living compartments, it is considered most improbable that lead poisoning ever results from chipping well-ventilated spaces as is ordinarily done on board ship, but when this work is concentrated in confined spaces such as double bottoms, cases of lead poisoning will follow unless the most rigid preventive measures are instituted and careful inspections made.

### Editor's Comment

Industrially the main portals by which lead enters the body are the respiratory tract, the gastrointestinal tract, and the skin. The absorption of lead introduced into the subcutaneous tissue and the intraperitoneal cavity is of experimental interest only.

The most obvious exposure of workmen to lead is by way of the skin. The characteristically besmeared hands and faces of painters and the covering of dust on the clothes and features of men handling dry lead compounds repeatedly raises the question as to whether lead can be absorbed by the intact skin. When experimental studies are employed, however, to test the validity of this plausible and attractive theory the results seem on the whole to be negative.

Nevertheless, such modern authorities as Legge and Goadby Meillere, Oliver, and Hamilton all agree that the intact skin is practically negligible as a portal of entry for inorganic lead compounds. There is danger, however, in making too liberal generalization from this statement. Numerous records of cases of plumbism resulting from the application of lead preparations to ulcers, burned areas, skin eruptions, as vaginal douches, or eye washes, etc., indicate that the broken or irritated surfaces may offer a much more ready path of entrance to lead. Neither can deductions as to the rate of absorption of organic lead compounds through the skin be drawn from experiments with aqueous solutions of lead salts. Many compounds which dissolve fat, as, for example, methyl salicylate and nitrobenzol, are known to penetrate the skin readily. The general opinion that there is danger of absorption in handling organic lead compounds such as lead tetraethyl is apparently well founded. Furthermore, the absence of cutaneous absorption should not be interpreted as a justification for any relaxation in the regulations for personal sanitation among lead workers. Although the hand itself probably does not absorb lead, it may still be the means of carrying lead compounds to the mouth or nose where ready entrance to the organism is offered.

*Absorption through the respiratory tract.*—The fact that lead is absorbed by the gastrointestinal tract is doubted by no one. Both experimental and accidental cases of lead intoxication have repeatedly occurred when lead could not possibly have entered by any other route. Moreover, Carlson and Woelfel have shown that even the most insoluble lead compounds dissolve to some extent in gastric juice. On the other hand, the persistent reiteration from Stockhusen's time to the present, by students of the industrial lead hazard, that the dusty trades are the most dangerous, suggests that more attention should be given to the respiratory tract as a portal of entry.

A series of experiments was conducted by Blumgart in which various lead compounds were introduced into the respiratory tract of normal animals. This was accomplished with very little respiratory disturbance by inserting a needle through the unbroken skin into the lumen of the trachea and injecting approximately 2 cubic centimeters of a suspension of lead carbonate or other salt in physiological saline. Undoubtedly some lead was swallowed in these cases, so that there was some gastrointestinal absorption, but the development of symptoms was so much more rapid in these animals than in the cats which had received far greater quantities of soluble lead by mouth that the relative danger involved in the two forms of exposure was clearly demonstrated. Lead lines appeared within four or five days and such typical signs of plumbism as loss of appetite, constipation, weakness, and nervous symptoms developed rapidly. If the insufflation of dust was repeated, intoxication soon became fatal.

When lead enters the body by way of the respiratory tract, both absorption and excretion involve transportation in the systemic blood, while lead entering through the gastrointestinal tract may be excreted without being absorbed, or after absorption may be caught by the liver and excreted in the bile without ever reaching the systemic circulation. Thus a large proportion of the lead absorbed from the gastrointestinal tract is confined to a region where it causes relatively little damage.

The course which lead follows from the time of entrance into the organism until it is excreted or stored explains in part the great danger involved in exposure to lead dust, and makes it quite evident that the dusty trades are the most hazardous because they allow absorption through the respiratory tract.

*Gastrointestinal absorption.*—Though the stomach is chiefly responsible for the solution of swallowed lead particles, there is no evidence that the absorption of lead is confined to any special part of the gastrointestinal tract. Some difference of opinion does, however, exist as to the region where absorption is most rapid.

Meillere and Brouardel believe that any mucous surface—hence the entire alimentary canal—can absorb lead. Legge and Goadby

state that absorption is very slight in the stomach and takes place most rapidly in the upper part of the small intestine. Somewhat opposed to this view is the opinion of Harnack that bile so reduces the rate of absorption that it becomes very slight in the part of the intestine where the bile enters.

The presence of food, and more especially of milk, in the gastro-intestinal tract has been generally supposed to decrease greatly the rate of lead absorption. This theory is based upon the arguments (*a*) that solution of solid lead compounds in the stomach is retarded by the reduction of acidity, and (*b*) that the food itself unites with lead to form comparatively insoluble compounds.

In the course of experimental work by Aub et al. lead acetate solution mixed with 75 cubic centimeters of milk was administered to one group of cats while to others the same doses (50 milligrams of lead per kilo of body weight) of lead were given in water 12 to 20 hours after the last food had been taken. In both cases lead was given on alternate days until death. There was no consistent nor significant difference between the quantities of lead retained in the body by the two groups of animals.

Thus, although the general belief in the value of a milk diet as a preventive of lead poisoning is undoubtedly well founded, the beneficial effect of milk is due to its dietary properties rather than to any effect on the absorption of lead.

The exact processes involved in absorption of lead from either the respiratory or gastrointestinal tract are not clearly understood; but certain observations have been made which point to the type of physiological reactions which occur. In the lungs the presence of polymorphonuclear leucocytes and mononuclear phagocytic cells containing lead indicates that phagocytosis probably aids absorption. The invariable storage of lead in the skeleton as the phosphate, no matter in what form it was administered, furnishes ample proof of true solution during absorption or transportation. Even with the extremely sensitive test which Cazeneuve devised for chromic acid, no chromate could be found in the bones after insufflation of lead chromate. To permit such solution a relatively high degree of acidity is necessary. Obviously, ingested lead can be dissolved in the acid of the gastrointestinal tract, but in the lungs some complicated mechanism must be involved in producing sufficient acidity. Perhaps the ready penetration of $CO_2$ through cell membranes permits the hydrogen ion concentration of the cells to increase to the point where solution can take place.

Lead poisoning is characterized by several clear-cut and typical signs and symptoms directly referable to the absorption and action of lead salts. It is striking that there is an enormous variation in

the immunity of different individuals to intoxication. No test is now known which demonstrates before exposure the degree of susceptibility, but by careful and frequent medical examinations of exposed individuals it is possible to recognize susceptibility before intoxication has really developed.

There are, however, several factors which tend to reduce immunity. Certain races seem to be predisposed to lead poisoning. That negroes are particularly susceptible has been stated by Edsall and also pointed out by several physicians in white-lead factories where negro labor is used. Sex and age also influence immunity. Children are said to be more easily poisoned than adults, and the prevalence of sterility and the frequent occurrence of abortion among women exposed to lead is evidence of their greater susceptibility. The numerous references to the rôle of the general bodily condition in determining individual susceptibility and immunity emphasizes the importance of this factor. In his book Oliver states that "poverty and general deprivation predispose to plumbism" while Edsall reports that "any preexisting disease that reduces the resistance, perhaps chronic renal trouble especially, increases the liability to attack." "Any sudden unusual exposure, a drinking bout, or an infection such as influenza," may produce acute symptoms. And, finally, previous attacks of lead poisoning facilitate the later development of symptoms, usually similar to those which appeared originally, but sometimes of quite different type. For instance, both colic and wrist drop may recur several times or a new manifestation, such as encephalopathy, may develop.

The painters' trade in every country has been brought under less complete control than any other lead trade, and it is the one that shows the least improvements in the rate of lead poisoning. For this reason the French are insisting on the abolition of lead paint, and they have already closed their white-lead factories and forbidden the use of lead paint on buildings. On the other hand, the British and German authorities on industrial hygiene lay stress on the toxic constituents other than lead which are present in almost all paint and also in paint removers, shellac, and varnish. These are volatile fluids such as turpentine, benzine, petroleum distillates, and wood alcohol, all of which are capable of producing more or less serious intoxication, and, according to this view, are really responsible for much of the ill health of painters which is usually attributed to lead.

Nevertheless, great efforts have been made in Great Britain and in most continental countries to minimize the dangers of lead paint by prohibiting dry rubbing down when lead paint is used, pro-

hibiting the mixing of dry white lead by the painter, restricting the use of white-lead paint in interior work, etc. Fortunately, the American tendency to speed up the job leads more and more to the abandonment of dry rubbing down in interior decoration, except on very high-class work, but it is still done in the painting of some automobile bodies and of practically all vehicle wheels.

The general impression obtains that less lead paint is used now than formerly, but interviews with white lead producers do not confirm this. There has certainly been an increased production of white lead in the United States since the war, and the painting trade is still the largest consumer, with the potteries coming next. A new danger to the painter has appeared recently in the introduction of the "spray gun" which has met with an enthusiastic reception and has spread rapidly. It is now used for painting all sorts of factory goods, not only small objects which may be placed in a cabinet with an exhaust, but automobiles, wagons, railway and trolley cars, agricultural machinery, furniture, and even the interiors of buildings. It is easy to see how this increases the danger of lead poisoning, for a spray of finely divided droplets, each carrying its tiny load of lead, is hard to control. The experiments of Sharpe, of Toronto, have shown that in such work the lead content of the air may go far beyond the limit of safety, and that the ordinary respirator lets a dangerous amount pass through. The Bureau of Mines has recently shown that a gas mask can be constructed which will hold back the lead, but it is certainly doubtful whether painters will consent to work in such a mask.

The prevention of lead poisoning may be difficult of execution, but the principles which must guide it are very simple. In almost all cases of industrial plumbism and in all serious cases, it will be found that the workman has been poisoned by lead which entered his body with the inspired air. This fact has been observed repeatedly in practice since it was first announced by Tanquerel des Planches a hundred years ago. He said:

> All the characteristic traits of the primary effects of plumbism may be quickly observed in workmen who are habitually in an atmosphere of lead dust and vapors. None of the primary effects are found among workmen who handle lead in a fixed state.

The practical experience of British and German factory inspectors bears out abundantly the assertion that the air must be kept free from lead dust and lead fumes (fume is a suspension of extremely fine particles of lead oxides and sulphate) if serious poisoning is to be prevented. Of secondary importance is the provision for personal cleanliness, but of course this should never be neglected.

Since the susceptibility to lead varies enormously in different individuals, and since it is impossible to detect this susceptibility at the time when the worker is employed, it is essential to have a medical examination of all lead workers at regular intervals. If any case of lead poisoning is discovered, the worker should at once be suspended from lead work and given other employment, preferably out of doors, till all symptoms of lead poisoning have disappeared.

The number of admissions and deaths resulting from acute and chronic lead poisoning which occurred in the United States Navy during the fifteen-year period 1913–1927, inclusive, are shown in the following table:

| Year | Average strength | Lead poisoning, acute | | Lead poisoning, chronic | |
|---|---|---|---|---|---|
| | | Cases | Deaths | Cases | Deaths |
| 1913 | 65, 926 | 25 | 0 | 36 | 0 |
| 1914 | 67, 141 | 34 | 0 | 30 | 0 |
| 1915 | 68, 075 | 46 | 0 | 24 | 0 |
| 1916 | 69, 294 | 45 | 0 | 20 | 0 |
| 1917 | 245, 580 | 19 | 0 | 21 | 0 |
| 1918 | 503, 792 | 12 | 0 | 13 | 0 |
| 1919 | 298, 774 | 19 | 0 | 11 | 1 |
| 1920 | 140, 773 | 4 | 0 | 1 | 0 |
| 1921 | 148, 861 | 3 | 0 | 1 | 0 |
| 1922 | 122, 126 | 7 | 0 | 7 | 0 |
| 1923 | 116, 565 | 25 | 1 | 8 | 0 |
| 1924 | 119, 280 | 1 | 0 | 6 | 0 |
| 1925 | 115, 391 | 6 | 0 | 3 | 0 |
| 1926 | 113, 756 | 26 | 0 | 9 | 0 |
| 1927 | 115, 316 | 27 | 0 | 7 | 0 |

There was a gradual reduction in the number of cases from 1915 to 1923. In the latter year 18 cases of acute lead poisoning developed during the month of November on board the U. S. S. *Simpson* at Constantinople, Turkey. Death occurred in one case.

Of the 26 cases of acute lead poisoning reported during the year 1926, 13 cases were caused by lead paint, but the manner in which the men were poisoned was not specified. Five other cases were caused by particles or dust from paint. Poor ventilation in double bottoms and bilges was regarded as the cause in six cases. One man was poisoned by a native drink, "aguardiente," which was distilled in containers lined with lead, and one by coming in contact with red lead.

In 1927, 9 of the 27 cases of acute lead poisoning resulted from chipping and painting aboard ship, but the circumstances which caused the poisoning were not mentioned. Chipping and painting in double bottoms caused poisoning in 13 cases and chipping in double bottoms in 5. In these cases deficient ventilation was regarded as the primary factor.

Reference: Aub, Fairhall, Minot, and Reznikoff, Lead Poisoning, 1926.

## DELETERIOUS EFFECTS FROM SERUM INJECTIONS[1]

By W. H. Park, M. D., Fellow, A. P. H. A. Director, Department of Health Laboratories, New York, N. Y.

Before considering these effects individually it will be well to review briefly our present knowledge as to the reason of the development of the reactions in susceptible individuals.

Hypersensitiveness in man may be observed after both the enteral and parenteral introduction of many and varied substances. These inducing substances may be divided into two groups, antigenic and nonantigenic, viz: Those which stimulate and those which do not stimulate the production of demonstrable antibodies. The degree of response to such substances is largely personal idiosyncracy and the symptoms, however diverse the agent, have a great deal of similarity. Coca has suggested that the term allergy, introduced by Von Pirquet, be limited to describe these individual peculiarities.

Because of the ease with which experimental animals may be rendered sensitive or anaphylactic, there has developed a general fear of a fatal outcome following injections of antitoxins and antiserums made some weeks or years after a previous injection. There is, however, direct evidence that man is much less liable to be similarly sensitized. In this connection it should be noted that attempts to render monkeys anaphylactic have failed. Longcope believes that the high degree of susceptibility in some people with spontaneous sensitiveness, the multiplicity or lack of specificity of sensitivity and the distinct tendency to occur in families differentiates these individuals from the artificially sensitized. Man may be sensitized in a way, as manifested by the accelerated or immediate reactions of serum sickness, the production of chills and fever by intravenous injections, or by the development of an increased skin sensitivity after serum administration.

Collapse or death has occasionally followed the second injection of antitoxin or antiserum, and seemingly is more likely to occur after intravenous or intraspinal injection where an interval of five days or more has elapsed after the first injection. These occurrences suggest that some individuals may actually be rendered anaphylactic. On the other hand, different lots of antitoxin and antiserum behave distinctly differently, and individuals of known sensitivity do not necessarily always react similarly to the substance to which they are sensitive. The danger of second injections to an individual is probably only slightly greater than that of first injections.

### Serum Reactions

The untoward symptoms elicited in man by the introduction of serums with or without antitoxins may be divided into those follow-

[1] Reprinted from the American Journal of Public Health, March, 1928.

ing the initial injection and those following the second or later injections. These reactions have nothing to do with the antibody content of the injected serum.

Following the first injection three types of reactions may be noted: (*a*) most frequently, a symptom-complex called "serum sickness"; (*b*) very rarely, collapse, with or without fatal outcome; (*c*) equally rarely, local necrosis. Each of these forms of response may follow the second or later injection.

*Collapse or death.*—This rare accident has been noted usually after the first injection. The symptoms develop quickly after the administration of the serum. In about 1 to 20,000 persons receiving primary injections of serum alarming symptoms develop; in about 1 to 50,000, death results. The symptoms are those of extreme dyspnea and collapse. The dose which will give alarming symptoms or even result fatally may be very small. Kerley reports a case of known hypersensitiveness where the dose was gradually increased until 4 minims were given; this resulted in alarming shock. It is probable that the greater frequency of deaths after first injections was because the number of first injections was so much larger. The individuals showing this type of reaction are commonly those subject to "hay fever or asthma" developing attacks especially in the neighborhood of horses. Children having a status lymphaticus are prone to develop collapse or die. Every precaution should be taken in giving antitoxins or antiserums to such cases or to those subject to asthma.

*Chills.*—A chill more or less severe is observed in about 10 per cent of the cases after the intravenous injection of refined antiserum and about 20 to 60 per cent of the cases after unrefined antiserum, even when injections are given very slowly and the material warmed to the body temperature. In the Willard Parker Hospital the frequent administration of antitoxin by the intravenous method has revealed that this probably depends on some special form of the protein or lipoid. With the best product of refined antitoxin globulins less than 1 per cent of intravenous injections produce a chill. There is considerable difference in this respect between different preparations of both refined and unrefined serum.

It should be emphasized that the development of sudden collapse is the condition to fear and prevent. Serum sickness is not fatal in itself, however alarming in appearance and uncomfortable the condition may be; even where two or even three successive waves of rash and edema ensue. This condition can not be prevented except by improvements in concentration methods, which will both modify and lower the content of protein substances in antitoxin and other antibody preparations. The giving of divided doses does not materially influence the subsequent development of serum sickness as, roughly,

the total quantity given is the determining factor in individuals of equal sensitiveness and with the same preparation of antitoxin.

*Serum sickness.*—The incidence of this type of reaction varies widely in different series of cases, being from 10 to 60 per cent or more, according to the preparation of serum used. The size of dose will influence to some degree the percentage incidence. Because of the lower protein content and also because of the heating, the concentrated globulin preparations of antitoxin cause a relatively low incidence. Following the first injection of serum or antitoxin there is an incubation period varying from 3 hours to 24 days. More commonly the period ranges from 3 to 12 days. The symptoms are primarily a skin eruption, edema, slight albuminuria, variable both in incidence and in degree, enlargement of the lymph nodes with pain and tenderness and pain in the joints. The eruption is very variable in character. A local eruption usually appears earlier than the general eruption. On the second or later injections the period of incubation may be absent or shortened, "immediate or accelerated reaction," although this does not always occur. This accelerated reaction is not more serious than the ordinary serum sickness. Some samples of unrefined serum uniformly cause skin eruptions (scarlatina form) earlier than others. The longer incubation periods are more frequently followed by urticarial rashes. It would seem from this that there were different reaction-inducing substances in serum or antitoxin.

*Severe local reactions.*—In very rare instances the primary injection of antitoxin leads to local necrosis. Although this occurs with extreme infrequency, it should be a warning against injection under the breasts. When repeated injections are given, a second or later subcutaneous injection somewhat more frequently results in a sharp local reaction which may go on to necrosis. This may occur not only with serum but also with rabies vaccine. The resemblance of this form of reaction to the Arthus's phenomenon in sensitized rabbits is marked. The necrosis is not due to bacterial contamination, but the necrotic area may become infected and serious or fatal results ensue.

### Tests Used to Indicate the Probability of Serum Reactions

While it is always advisable, in general it is not expedient to test the sensitivity of every case before the administration of antitoxins or antiserums. Careful inquiry should be made as to known allergy, such as hay fever, asthma, or food idiosyncrasies. Those giving a definite or suspicious history may then be tested by the intracutaneous injection of about 0.1 cubic centimeter of serum, or antitoxin diluted 1 to 10, or the instillation of a drop of the undiluted serum, or a 1 to 5 dilution in the eye.

It is important that epinephrine be immediately available when doing an ophthalmic test since in rare instances a severe reaction has occurred. The instillation of epinephrine should be immediately available when doing an ophthalmic test since in rare instances a severe reaction has occurred. The instillation of epinephrine will check the progress of the reaction. Of the two tests, the latter is the more reliable index of the probability of a serious general reaction, but because of crying it is somewhat difficult to use accurately in young children, both because it is partly washed out and because of congestion of the conjunctiva in the other eye.

Untoward results may occur in persons not giving a positive test. The presence of skin sensitiveness, as shown by the prompt development within 20 minutes of a definite wheal at the site of intracutaneous injection which is considerably larger than the original wheal made by the injection, usually indicates that serum sickness with local or general rash will develop, and more quickly than usual. The late area of hyperaemia which develops at the site of the injection is of little if any significance. Children which show this late reaction from an intradermal injection of the serum from one horse often will not react to the serum from another horse. The rare cases with symptoms of shock with or without death are more likely to occur than in those not skin sensitive. The eye test seems to be even a better index of the probability of a serious reaction.

In those where because of history or preliminary test, or both, there is reason to fear a general reaction, about 0.05 cubic centimeter of serum or antitoxin may be given subcutaneously, and then gradually increased-sized doses, such as 0.1 to 0.2 cubic centimeter, given every 15 minutes until a slight reaction indicates that the tolerance of the patient is reached or sufficient serum is given. Should an intraspinous or intravenous injection be required, it becomes a problem of comparative dangers of withholding the serum or risking the reaction. Several preliminary subcutaneous injections may be tried (as above) before attempting intravenous injection, giving then only a very small amount, pausing for some minutes, and then giving the remainder very, very slowly. Dilution with saline solution wherever possible is an aid in this regard.

Even with all these precautions a severe reaction or even a fatal result may occur. Thus, a young woman, who had received 80 cubic centimeters of antistreptococcic serum intramuscularly, required at the end of three weeks an intravenous injection. She was given at short intervals 0.5, 1.2, and 4 cubic centimeters of serum subcutaneously. No appreciable local or general reaction occurred. An intravenous injection was then given. When the amount reached 10 cubic centimeters, while it was being administered very slowly, she com-

plained of premonitory symptoms of beginning shock. The injection was immediately suspended, but the symptoms increased and death soon resulted. The first injection of serum, although it produced no immediate effect, did cause serum sickness on the eighth day. Such cases are fortunately rare.

### Desensitization to Serum

Instances are noted with some frequency where first injections have caused reactions and following injections given several hours or even a day later have produced little or none. This would seem to indicate a desensitization. Different batches of bactericidal or antitoxic serum will vary widely in their rash and temperature producing qualities, and this may have been a factor in the development or non-development of symptoms. The administration of small doses of serum, prior to a first large injection or prior to subsequent injections of those known to be sensitive, has not the regularity of desensitization noted in experimental animals. Divided doses may fail to give a reaction or repeated small doses may apparently induce a tolerance, but this is no proof that we are inducing the mechanism of desensitization so uniformly producible to experimental animals. In persons suffering from lobar pneumonia where frequent injections of antiserum are given intravenously the first injection of serum frequently produces a chill. Subsequent injections of the same dose rarely produce one, but if the dose is markedly increased, a second chill frequently follows. Even the same amount of a different preparation is more apt to produce a chill.

### Methods of Eliminating the Reacting Substances from Antiserums

Concentration methods (globulin separation) have had effect in reducing the incidence of rashes. Heating the antiserums to 56° C. before concentration is of distinct value; likewise the preliminary saturation with sodium chloride and the use of the clear filtrate for the subsequent steps in the ammonium sulphate method of purification. Aging of antiserums or of globulin preparation is of distinct value. Crystal clear products are less likely to cause chills and the aging before filtration is more likely to yield a product which will remain clear. Starving of horses prior to bleeding does not seem to influence the content of reacting substances. Keyes and Carey advise the addition of calcium chloride and cephalin to remove the residual fibrin-forming substances still remaining after clotting. They believe that chills may be prevented in this way. In a little preliminary work we have not been able to remove the chill-producing substance by utilizing what we believe to be their method.

### Treatment of Developed Shock

Hypodermic injection of epinephrine or atropine will usually relieve the less severe attacks. In extreme collapse artificial respiration may be tried.

### Effect of the Serum in Toxin-Antitoxin in Sensitizing Human Beings to Later Injections of Serum

Let us first approach this subject from the experimental side. It has long been known that minute quantities of serum will sensitize guinea pigs so that they will show some reaction after a delay of several weeks to later doses of serum. It is not usually remembered, however, that these small doses frequently do not sensitize guinea pigs to the extent that any appreciable reaction follows from large intracardial injections of serum. Recently we have given a number of guinea pigs several times the proportional amount of serum which human beings would get from toxin-antitoxin and none of these guinea pigs have died from 1 cubic centimeter of serum injected intracardially. Several showed no symptoms at all; others had slight spasmodic contractions, scratched their nose and showed evidences of slight anaphylactic shock. They all made good recoveries.

Further, it should be remembered, as already stated, that the guinea pig is far more susceptible than other animals and so probably far more so than man. If we turn to skin reactions, we find as first pointed out by Hooker that after intracutaneous injections of 0.1 cubic centimeter of a 1 per cent horse serum and three injections of the old toxin-antitoxin mixture, that these persons showed a year later a marked increase in the number which reacted to a second intracutaneous serum test.

It should be noted that not only did Hooker use a preliminary injection of serum which contained more serum than the three injections of the present toxin-antitoxin mixture, but he also used the old preparation of toxin-antitoxin which contained thirty times as much serum as the present mixture. Repeating his tests on children that had not received a previous intracutaneous injection, I found that there was only a moderate increase in the percentage of skin reactions among those who had received toxin-antitoxin and that none of these were extensive reactions.

From long experience in using preliminary intracutaneous tests to discover those who might show anaphylactic shock, we have learned that only those skin reactions which are extensive suggest the probability of anaphylactic shock or severe accelerated reactions. Those that show minor skin reactions as well as those that show no skin reactions may develop anaphylactic shock, but do so less frequently. Then we have the final test as to whether a given number

of persons who have received three injections of the present toxin-antitoxin mixtures show more accelerated reactions or serious cases of serum sickness or true anaphylactic shock of necrosis than those who have not received these injections.

I have had the opportunity of making a comparison in more than 100 individuals who had received toxin-antitoxin and in more than 100 individuals who have not received toxin-antitoxin. The total number of children was obtained by combining several different tests on different groups. In my experience there was no appreciable difference in the reactions following serum injections in those who had toxin-antitoxin and in those who had not. If isolated cases in which marked reactions occur which happen in those who had toxin-antitoxin previously are reported, it is misleading because similar cases could be reported in those which have not received such injections. It is only by comparing the two lots that accurate information can be obtained.

A striking instance of this was the recently published case of necrosis in a nurse following a second injection of antitoxin which followed 10 days after the first injection. The caption over this report was gangrene following an injection of serum in a case which had previously received toxin-antitoxin. We know that an injection of serum following another given 10 days previously not infrequently is followed by a reaction, while the fact that the first injection of serum gave no reaction definitely rules out the toxin-antitoxin given a year previously as being in any way responsible.

There was recently reported to me the case of a young girl who nearly died after a dose of scarlet-fever antitoxin. She had not had toxin-antitoxin or any previous serum injection. If she had had, it would have been considered as the predisposing cause.

From my own observations I am not at all worried by the slight degree of skin sensitization which may be produced by toxin-antitoxin. Fortunately, if anyone is worried we can turn to goat toxin-antitoxin or to toxoid. These preparations when they are properly made and when they have successfully passed tests for immunizing potency are equal in value to toxin-horse-antitoxin. This we are doing in New York, and probably this change will in time become general.

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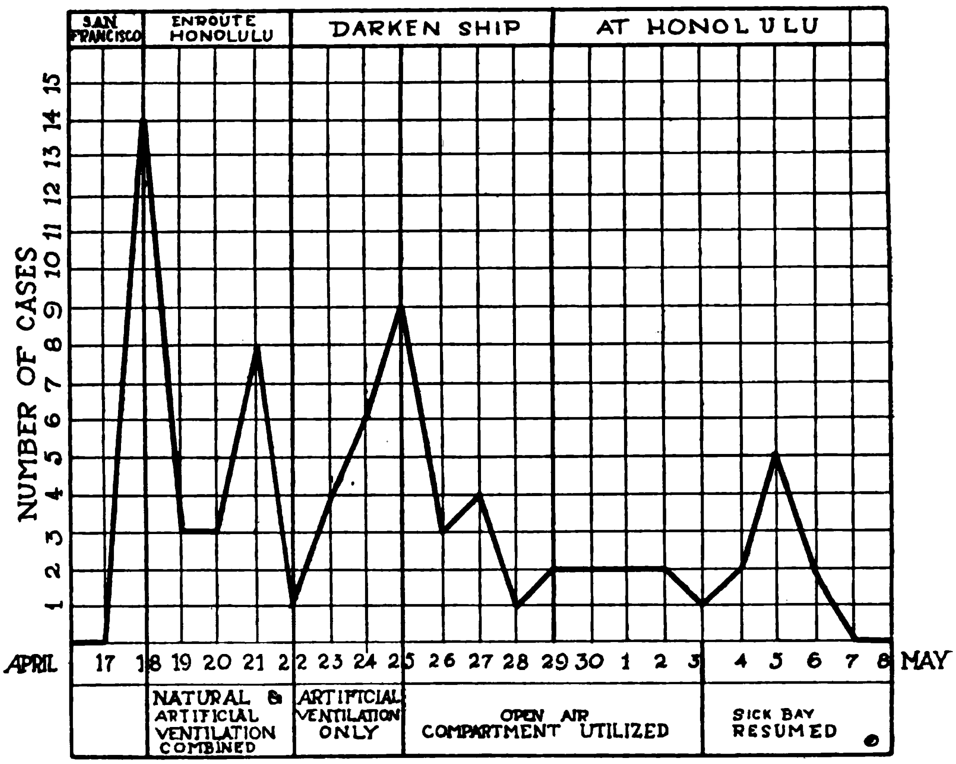
## REPORT OF AN OUTBREAK OF INFLUENZA ON BOARD THE U. S. S. "IDAHO"

By F. G. ABEKEN, Commander, Medical Corps, United States Navy

An outbreak of mild influenza comprising 74 cases occurred between April 17 and May 6, 1927, among the crew of the U. S. S. *Idaho*. Clinically the symptoms were characteristic of influenza and, as shown by white-blood cell counts, accompanied by a leukopenia in

every case. The respiratory type predominated over the gastro-intestinal type. The explosive nature of the outbreak with the steeplelike curve, so frequently noted during the World War, is indicated in the following chart:

CHART




The U. S. S. *Idaho* arrived at San Francisco, Calif., from San Pedro, on April 10, and remained until April 18, 1928. The disease was undoubtedly contracted by men ashore on liberty parties while the ship was at anchor in San Francisco Bay. The sudden change from the mild equable temperature prevailing in the vicinity of San Pedro to the colder climate of the more northern part, and the exposure of the men to cold moist winds at night while waiting at the landing floats and while returning to the ship in open motor boats, were thought to be predisposing factors.

On April 18, the U. S. S. *Idaho* left San Francisco for a 10-day cruise to Honolulu, during which period the ship was in fleet formation and engaged in a battle problem that necessitated darkening the ship at night. This maneuver required the closing of all battle and gun ports which precluded all natural ventilation by diffusion or perflation. The nightly interference with natural ventilation and the crowding caused by the admission of many patients to the sick bay, not only prolonged recovery and favored complications, but affected the symptoms in such a manner that they were aggravated

or more pronounced in the morning than at night. The evening temperatures varied from 101° to 102° F., while the same patients, contrary to expectation, had temperatures which ranged from 103° to 104° F. the following morning.

The problem was solved by resorting to open air for both prevention and treatment and as a measure to minimize complications. To accomplish this, the forward starboard 5-inch gun compartment on the upper deck, together with the adjoining passageway on the open deck, were converted into a temporary sick bay. The passageway was protected from the direct rays of the sun by spreading an awning overhead, and all artificial lights within the compartment were either removed or disconnected in order that no lights could possibly be visible through the open ports at night. These procedures insured plenty of fresh air for the patients both day and night and at the same time did not interfere with the battle problem.

Isolation of many cases during an epidemic, while exceedingly difficult on board a ship on the high seas, is a very effective factor in the control of the outbreak. Another factor of importance is the recognition and isolation in bed of all men having fever.

This method of prophylaxis and the hospitalization of all persons with early symptoms were the only preventive measures employed.

All patients responded well to the open-air treatment and were returned to duty with an average time in bed of four days. The noteworthy feature of this outbreak was the effect of the conditions caused by a war problem upon the sick when confined below decks, and the importance of having ample hospital or bed accommodations to permit the enforcement of preventive measures.

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## A SMALL OUTBREAK OF FOOD POISONING ON BOARD THE U. S. S. "TRENTON" ATTRIBUTED TO CHICKEN SALAD

By R. D. Mackey, Lieutenant Commander, Medical Corps, United States Navy

An outbreak of food poisoning occurred on board the U. S. S. *Trenton* on February 23, 1928, while the ship was anchored in Guantanamo Bay, Cuba. Food eaten at a smoker on board the U. S. S. *Milwaukee* during the previous evening appeared to be unquestionably responsible, as all the men affected had attended the smoker, while food which had been served on board this ship was not suspected. However, the menus were inspected and all the men who had not attended the smoker were questioned for possible symptoms.

The refreshments served at the smoker included chicken salad, potato salad, assorted sandwiches, ice cream, cake, and lemonade. The salads were at once suspected as the methods ordinarily used in their preparation offer opportunities for contamination which are

often difficult to prevent. While it was possible that the sandwiches and ice cream might have been the cause, this seemed unlikely when it was learned that a number of men had partaken of these foods without ill effects. The same was true to a lesser degree in the case of the potato salad, while the cake and lemonade were at once eliminated from consideration.

The remaining food, the chicken salad, was then thought to be responsible for the outbreak, and this belief was strengthened when it was found that all the affected men had eaten some of the salad, and that some of the mess attendants had swallowed but a mouthful "because it had a peculiar taste."

Of the 108 men who attended the smoker from this vessel 78 stated they had eaten some of the chicken salad, and of these 44 men were affected. Symptoms sufficiently severe to require admission to the sick list occurred in 24 instances, while in 20 they were so mild that the patients were given treatment and returned to duty. It is interesting to note that only one of the seven mess attendants who were at the smoker, and who had eaten only a mouthful of the chicken salad because of the peculiar taste, developed symptoms. Two men stated upon question that while they had not eaten any of the salad, they had cramps during the night, but it was believed that these two cases were coincidental. The first patient was taken ill within two hours and the last seven hours after the ingestion of the food.

All of the patients were pale, while those admitted to the sick list had, in addition, muscular tremors and profuse perspiration. The onset of symptoms was sudden in all cases. Nearly all the patients were awakened from a sound sleep by the onset of symptoms. One man who was on watch felt weak and dizzy before the onset of abdominal cramps and one had a burning sensation in the stomach when he turned in at midnight, but slept well until he was awakened by nausea and vomiting about two and one-half hours later. In 14 cases the men were awakened by severe cramps rapidly followed by nausea, vomiting, and watery diarrhea. In 4 cases nausea and vomiting preceded cramps and diarrhea, in 4 nausea and vomiting occurred without cramps or diarrhea, and in 2 cases there were cramps with nausea and vomiting but no diarrhea. All the patients complained of abdominal pain, which they described as cramps, except one who stated that he had cramps in the back of the legs and two who complained of cramps in the same location in addition to the abdominal pain. Vomiting occurred in all cases but, even with those most severely affected, ceased within three or four hours. There was no abdominal distention. A profuse watery diarrhea occurred in 18 cases of the 24 admitted to the sick list.

No blood was seen in any stool. A large number of the patients experienced chilly sensations after several hours but did not have a frank chill. Fever with a temperature of 99.8° F. was noted in only one case while the temperature in the remaining cases was either normal or slightly subnormal.

Two patients complained of severe headache referred to the occipital region. No patient complained of general aching or soreness. Moderately severe prostration developed quite suddenly in the 24 cases admitted to the sick list. Except for a few patients who complained of a burning or bitter taste, no change in the oral secretions was noted. No patient developed ocular symptoms. The average pulse rate was 86 while the extremes were 98 and 72, respectively. No irregularities of the pulse were observed. Respiration was essentially normal though slightly accelerated in a few cases. No patient exhibited a skin eruption at any time during the course of the disease. Neither were blood pressure readings nor blood counts made.

The urine and feces of the three patients most severely attacked were sent to the laboratory of the U. S. S. *Mercy* for examination and culture. The report stated that with the exception of a very faint trace of albumin in one specimen nothing unusual was noted and the cultures of both urine and feces were negative for pathogenic bacteria.

While it has not been proved that chicken salad contaminated by bacilli of the paratyphoid-enteritidis group was responsible for the outbreak, it is believed that this is a very reasonable assumption. Whatever food was responsible, the symptoms, except for the absence of fever, are very similar to those caused by this group of microorganisms. While it is understood that the cases occuring on other ships in the division did not require admission to the sick list, the 24 men admitted on board the U. S. S. *Trenton* were acutely ill and many of them showed the effects of their experience, notably anorexia, weakness, and malaise, for several days. Since men tend to form "ship groups" at entertainments of this sort, it is possible that an uneven distribution of the contaminated material may account for the variation in the severity of the outbreak on board the other ships.

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### A SMALL OUTBREAK OF FOOD POISONING ON BOARD THE U. S. S. "MILWAUKEE"

An outbreak of food poisoning which occured on board the U. S. S. *Milwaukee* at Guantanamo Bay, Cuba, February 23, 1928, was reported by R. J. Trout, Medical Corps, United States Navy.

The suspected food was chicken salad served about 11 o'clock the previous evening following a smoker on board the ship. Potato salad, assorted sandwiches, lemonade, ice cream, and cake were also included in the refreshments. The possibility of poisoning by food other than that served at the smoker was eliminated as men from four other ships and localities were affected.

The first indication of illness appeared about three hours after the food was eaten. It was estimated that more than 200 members of the crew ate the salad and 39 were poisoned.

Clinically, the symptoms of poisoning, which were similar to those in the outbreak on the U. S. S. *Trenton*, were very much the same in all cases but were of different degrees of severity. The onset was sudden in all cases. All patients had slight prostration, nausea, and vomiting, abdominal cramps and diarrhea. A few complained of headache and one had quite a severe chill. Bacteriological examination of the vomitus was negative.

Samples of the food were examined in the laboratory of the U. S. S. *Mercy*. Cultures from both the chicken salad and sandwiches showed a growth of the *Bacillus coli communis*. The laboratory reported as follows:

> Food was fed to guinea pigs without ill effect. The colon bacilli being present in foodstuff shows contamination, and, in view of the fact that samples received on board were 24 hours old, the colon bacilli probably outgrew any pathogenic organisms if such were present.

The chickens from which the salad was prepared were purchased in New York City under regular Navy contract and were received on board in a frozen condition while the ship was at the navy yard in that port, on December 14, 1927. Cold weather prevailed at that time and the temperature was below freezing. They were immediately placed in cold storage and kept well frozen until removed to the butcher shop about 8 a. m. the day of the smoker. The chickens were drawn about 10 a. m. while still frozen, cooked by boiling until about noon, and the meat picked from the carcasses during the afternoon. Other ingredients were hard-boiled eggs, celery, green peppers, onions, and mayonnaise dressing. These articles, which had been obtained from the U. S. S. *Bridge* on February 6, 1928, were fresh and had been handled in a sanitary manner. No canned foods were included. The salad was mixed in galvanized steel tubs, which with other containers had been thoroughly cleaned about one hour before it was served, cafeteria style, on wax-paper plates.

## REPORT OF AN ISOLATED CASE OF FOOD POISONING OCCURRING AT THE UNITED STATES NAVAL STATION, PEARL HARBOR, HAWAII

By E. A. SHARP, Lieutenant Commander, Medical Corps, United States Navy

Before going on watch at midnight, the patient, a radio man, second class, United States Navy, ate a sandwich made with a pork chop obtained from the ice box in the galley of the High Power Radio Station at the United States Naval Station, Pearl Harbor, Hawaii. On a platter next to the one containing the pork chop, he noticed some hamburger steak which had an offensive odor. He deposited the hamburger steak in the garbage can but did not recall washing his hands before eating the sandwich.

About six hours after eating, he began to have eructations and felt as though his abdomen were full of gas. Soon after the first eructation severe nausea, followed by vomiting, developed and continued at frequent intervals during the next four hours. He was brought to the hospital two hours after the onset of symptoms.

Upon admission, the patient's temperature was 99.8°, rising to 100.8° within several hours; pulse, 88; and respiration, 25. He had a pallid appearance and complained of a bitter taste, great weakness, abdominal cramps, and diplopia. A physical examination revealed dilated pupils which reacted well to light and distance, a moist skin, faintly coated tongue, and general abdominal tenderness accompanied with slight tympanites. Severe vomiting of blood-tinged material continued at from 10 to 20 minute intervals until gastric lavage was started, when the vomiting was readily controlled. As diarrhea did not occur, the bowels were opened by means of enemata followed by colonic irrigations. To combat the prostration, salt solution was given intravenously three hours after admission. Recovery was uneventful, and the patient was returned to duty in three days.

*Laboratory report.*—No culture was made from the urine, which was normal. A white-blood cell count showed a total of 23,100 cells, with polymorphonuclears 95 per cent and lymphocytes 5 per cent. A culture made from the vomitus was positive for the *Bacillus enteritidis*. None of the hamburger steak, nor the food eaten, was obtainable for examination.

It is believed that this sporadic case of food poisoning by the *B. enteritidis* was caused by the transference of material direct from the infected hamburger steak to the food eaten through the medium of the patient's hands.

## QUARANTINE TREATMENT OF UNITED STATES NAVAL VESSELS AT UNITED STATES PORTS

The following letter received from the Public Health Service is published for the information of the service:

FOREIGN QUARANTINE DIVISION CIRCULAR No. 32

To: Medical Officers in Charge, United States Quarantine Stations, and Others Concerned.

Subject: Quarantine Treatment of United States Naval Vessels at United States Ports.

Reference: Quarantine Laws and Regulations of the United States, paragraphs 140–144; Department Circulars Nos. 396 and 398.

In order to promote uniformity of procedure at United States ports in the quarantine treatment of vessels belonging to the United States Navy, the following supplemental instructions are hereby issued for your information and guidance:

1. Vessels of the United States Navy which carry a medical officer, upon entering United States ports from foreign ports, are exempt from quarantine inspection, provided that such vessels have not sailed from a port infected with cholera, yellow fever, or plague, or in which typhus or smallpox are epidemic, and further provided, that no cases of these quarantinable diseases have occurred on board en route. Naval vessels coming within the above provisions will radio to the naval authorities at the port of destination for relay to the quarantine officer, or will radio direct to the quarantine officer a report of the pertinent facts, including a statement by the ship's medical officer, to the effect that no cases of these quarantinable diseases have occurred on board during the voyage. This radio will then be confirmed by a letter from the ship's medical officer, addressed to the quarantine officer, immediately after the vessel has arrived in port.

2. All vessels of the United States Navy which have called at any port which is infected with any of these quarantinable diseases, and all naval vessels from any port having cases of these quarantinable diseases on board at time of arrival or en route, and all naval vessels not carrying a medical officer arriving from foreign ports, are required to stop at quarantine for inspection and such subsequent treatment as may be necessary.

3. All naval vessels sailing from ports in the possessions or dependencies of the United States bound for ports in the United States, its possessions or dependencies, are required to take out bills of health, but in the absence of the existence of any of these quarantinable diseases in such ports of departure or call, or on board, are not required, exclusive of vessels from ports in the Philippine Islands, to stop for quarantine inspection at port of arrival. Should any of these quarantinable diseases occur on board or exist in such ports of call or departure in the possessions or dependencies of the United States, then quarantine inspection is required upon arrival at ports in the United States, its other possessions or dependencies.

4. The evidence as to the presence or absence of these quarantinable diseases in a foreign port, or a port in the possessions or dependencies of the United States, is presented through American bills of health required to be taken out by the vessel at such ports of departure or call.

5. When two or more vessels of the smaller type, such as destroyers, one of which carries a medical officer, are cruising together, each vessel is con-

strued as equivalent to carrying a medical officer, and they may be reported by radio, including each ship in the squadron or division, and confirmed upon arrival by a letter from the squadron or division medical officer.

6. Naval transports and other vessels of the United States Navy not carrying a naval medical officer are subject to the same provisions of the quarantine laws and regulations as apply to merchant vessels.

7. All ports not in the United States, its possessions or dependencies, and ports in the Philippine Islands, are foreign ports; accordingly, Guantanamo Bay, Cuba, is necessarily considered under the law as a foreign port, although it is actually under the supervision of the Navy Department. Ports in the Philippine Islands have a quarantine status equivalent to that of foreign ports. A bill of health, or a supplemental bill of health, should therefore be obtained from the medical officer prior to departure, and vessels from such ports will be treated in accordance with the instructions applying to naval vessels from foreign ports.

## HEALTH OF THE NAVY

Based on returns for diseases and injuries occurring in April, May, and June, 1928, the general admission rate was 551 per 1,000 per annum. The corresponding rate for the first quarter was 380 per 1,000. Based on the experience of the past five years, the expected rate from all causes would be 476 per 1,000 for the second quarter.

The admission rate from disease was 501, which is a little greater than the expected rate, 456. The admission rate from accidental injuries, 48 per 1,000, was lower than for corresponding periods of previous years.

The incidence of acute respiratory diseases was considerably greater than during the winter months. Catarrhal fever exceeded expectancy at many shore stations in the United States. The United States naval training station, San Diego, Calif., reported 67 cases in April, 103 in May, and 117 in June; the United States naval training station, Great Lakes, Ill., 91 in April, 74 in May, and 32 in June; and the United States naval training station, Newport, R. I., 58 in April, 45 in May, and 25 in June. The United States naval training station, Hampton Roads, Va., was remarkably free from the disease during the quarter. An outbreak of mumps which started at the latter station in January continued through the second quarter of the year. The incidence of the disease, by months, January to June, inclusive, was as follows: 7, 21, 57, 68, 33, and 10. Two cases of cerebrospinal fever were reported by the United States naval training station, Great Lakes, Ill., one in April and one in June, and one case was notified by the United States naval training station, Newport, R. I., in May.

The admission rate, all causes, for forces afloat was 457 per 1,000 per annum for the quarter, as compared with the corresponding median rate for the preceding five years, which is 568.

Catarrhal fever exceeded expectancy on board most ships attached to the Battle Fleet. The U. S. S. *Mississippi* reported 11 cases of mumps in May and 21 cases of measles in June. No case of cerebrospinal fever was reported by forces afloat during the quarter.

TABLE No. 1.—*Summary of morbidity in the United States Navy and Marine Corps for the quarter ended June 30, 1928*

| | Forces afloat | Forces ashore | Marine Corps | Entire Navy |
|---|---|---|---|---|
| Average strength | 75, 185 | 39, 711 | 19, 366 | 114, 896 |
| All causes: | | | | |
| Number of admissions | 8, 581 | 7, 242 | 2, 676 | 15, 823 |
| Annual rate per 1,000 | 456. 53 | 729. 72 | 552. 72 | 550. 86 |
| Disease only: | | | | |
| Number of admissions | 7, 764 | 6, 632 | 2, 348 | 14, 396 |
| Annual rate per 1,000 | 413. 06 | 668. 02 | 484. 97 | 501. 18 |
| Communicable diseases, exclusive of venereal disease: | | | | |
| Number of admissions | 2, 704 | 3, 346 | 899 | 6, 050 |
| Annual rate per 1,000 | 143. 86 | 337. 03 | 185. 69 | 210. 62 |
| Venereal diseases: | | | | |
| Number of admissions | 2, 363 | 876 | 582 | 3, 239 |
| Annual rate per 1,000 | 125. 72 | 88. 24 | 120. 21 | 112. 76 |
| Injuries: | | | | |
| Number of admissions | 783 | 594 | 326 | 1, 377 |
| Annual rate per 1,000 | 41. 66 | 59. 83 | 67. 33 | 47. 94 |
| Poisoning: | | | | |
| Number of admissions | 34 | 16 | 2 | 50 |
| Annual rate per 1,000 | 1. 81 | 1. 61 | 0. 41 | 1. 74 |

TABLE No. 2.—*Deaths reported, entire Navy, during the quarter ended June 30, 1928*

| | | Navy | | | Marine Corps | | Nurse Corps | Total |
|---|---|---|---|---|---|---|---|---|
| | | Officers | Midshipmen | Men | Officers | Men | | |
| Average strength | | 8, 722 | 1, 399 | 84, 834 | 1, 191 | 18, 251 | 499 | 114, 896 |
| CAUSE: DISEASES | | | | | | | | |
| Primary | Secondary or contributory | | | | | | | |
| Abscess, liver | Abscess, multiple, right lung. | | | 1 | | | | 1 |
| Do | Septicemia | | | 1 | | | | 1 |
| Appendicitis, acute | do | | | 1 | | | | 1 |
| Appendicitis, chronic | Pneumonia, lobar | | | 1 | | | | 1 |
| Cerebrospinal fever | None | | | 3 | | 2 | | 5 |
| Do | Meningitis, cerebrospinal | | | 1 | | | | 1 |
| Do | Pneumonia, broncho | | | 1 | | | | 1 |
| Do | Pneumonia, lobar | | | 1 | | | | 1 |
| Calculus, kidney | Operative shock | | | 1 | | | | 1 |
| Carcinoma, right cheek | Pneumonia, broncho | | | 1 | | | | 1 |
| Carcinoma, pancreas | None | | | 1 | | | | 1 |
| Carcinoma, tongue | Pneumonia, broncho | | | 1 | | | | 1 |
| Chorea, exhaustion from | None | | | 1 | | | | 1 |
| Diphtheria | Myocarditis, acute | | | | | 1 | | 1 |
| Epithelioma, parotid gland | Pneumonia, lobar | | | | | 1 | | 1 |
| Influenza | Meningitis, cerebrospinal | | | 1 | | | | 1 |
| Do | Pneumonia, broncho | | | 2 | | 1 | | 3 |
| Malaria | Nephritis, acute | | | 1 | | | | 1 |
| Meningitis, cerebrospinal | None | | | 1 | | | | 1 |
| Myocarditis, chronic | do | | | 1 | | | | 1 |
| Nephritis, chronic | do | | | 1 | | | | 1 |
| Osteomyelitis, right humerus | Pyemia | | | 1 | | | | 1 |
| Otitis, media, acute | Meningitis, cerebral | | | 1 | | | | 1 |
| Do | Pneuminia, lobar | | | 1 | | | | 1 |
| Pneumonia, broncho | Abscess, multiple, right lung. | | | 1 | | | | 1 |

TABLE No. 2.—*Deaths reported, entire Navy, during the quarter ended June 30, 1928*—Continued

| | | Navy | | | Marine Corps | | Nurse Corps | Total |
|---|---|---|---|---|---|---|---|---|
| | | Officers | Midshipmen | Men | Officers | Men | | |
| **CAUSE: DISEASES** | | | | | | | | |
| **Primary** | **Secondary or contributory** | | | | | | | |
| Pneumonia, lobar | None | 1 | | 8 | | 2 | | 11 |
| Do | Nephritis, acute | | | 1 | | | | 1 |
| Do | Pericarditis | | | 1 | | | | 1 |
| Do | Pleurisy, suppurative | | | 2 | | | | 2 |
| Pyelonephritis | Septicemia | 1 | | | | | | 1 |
| Scarlet fever | Pneumonia, broncho | | | | | 1 | | 1 |
| Septic sore throat | do | | | 1 | | | | 1 |
| Tonsillitis, acute | do | | | 1 | | | | 1 |
| Tuberculosis, chronic pulmonary. | None | | | 1 | | 1 | | 2 |
| Do | Abscess, inter-lobar, left lung. | | | 1 | | | | 1 |
| Do | Tuberculosis, larynx and intestines. | | | 1 | | | | 1 |
| Ulcer, stomach | Peritonitis, general acute | | | 1 | | | | 1 |
| Total for diseases | | 2 | | 44 | | 9 | | 55 |
| **CAUSE: INJURIES AND POISONINGS** | | | | | | | | |
| **Primary** | **Secondary or contributory** | | | | | | | |
| Burns, multiple | Pneumonia, broncho | | | 1 | | | | 1 |
| Crush, head, neck, and chest. | None | | | | | 1 | | 1 |
| Drowning | do | 1 | | 11 | | 2 | | 14 |
| Seaplane crash: Drowning | do | 2 | | | | | | 2 |
| Landplane crash: Drowning. | do | 2 | | | | | | 2 |
| Electric shock, injury from | do | | | 1 | | | | 1 |
| Fracture, compound, skull | do | | | 1 | | | | 1 |
| Fracture, simple, vertebræ | do | | | 1 | | | | 1 |
| Intracranial injury | Hemorrhage, pons | | | 1 | | | | 1 |
| Injuries, multiple, extreme | None | | | 3 | | | | 3 |
| Do | Hemorrhage, internal | | | 1 | | | | 1 |
| Landplane crash: Injuries, extreme. | None | 1 | | 2 | 1 | 1 | | 5 |
| Rupture, traumatic, liver | Hemorrhage intraabdominal. | | | 1 | | | | 1 |
| Do | Hemorrhage, liver | | | 1 | | 1 | | 2 |
| Rupture, traumatic, urinary bladder. | Septicemia | | | 1 | | | | 1 |
| Strangulation, neck, rope | None | | | | | 1 | | 1 |
| Wound, gunshot, chest | do | | | | | 1 | | 1 |
| Wound, gunshot, chest and back. | Septicemia | | | 1 | | | | 1 |
| Wound, gunshot, chest and shoulder. | None | | | | | 1 | | 1 |
| Wound, gunshot, neck and left shoulder. | do | 1 | | | | | | 1 |
| Wound, penetrating, brain | do | | | | | 3 | | 3 |
| Wound, penetrating, heart | Psychosis, unclassified | | | 1 | | | | 1 |
| Wound, lacerated, right leg | Pneumonia, broncho | | | 1 | | | | 1 |
| Wound, penetrating, left hypocondriac region. | Hemorrhage, traumatic, renal artery. | | | | | 1 | | 1 |
| Poisoning, acute, bichloride of mercury. | None | | | | | | 1 | 1 |
| Poisoning, acute, cocaine | Alcoholism, acute | | | | | 1 | | 1 |
| Total for injuries and poisoning. | | 7 | | 28 | 1 | 13 | 1 | 50 |
| Grand total | | 9 | | 72 | 1 | 21 | 1 | 1.04 |
| Annual death rate per 1,000, all causes | | 4.13 | | 3.39 | 3.36 | 4.82 | 8.02 | 3.65 |
| Annual death rate per 1,000, diseases only | | .92 | | 2.07 | | 1.97 | | 1.91 |
| Annual death rate per 1,000, drowning | | 2.28 | | .52 | | .44 | | .63 |
| Annual death rate per 1,000, injuries | | .92 | | .80 | 3.36 | 2.19 | | 1.07 |
| Annual death rate per 1,000, poisoning | | | | | | .22 | 8.02 | .04 |

## STATISTICS RELATIVE TO MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

The following tables were constructed with figures taken from monthly reports submitted by naval training stations:

*Cumulative data*

| | Number | Per cent of recruits received | Per cent of recruits reviewed |
|---|---|---|---|
| JAN. 1 TO DEC. 31, 1927 | | | |
| All naval training stations: | | | |
| Recruits received during the period | 21,323 | | |
| Recruits appearing before board of medical survey | 937 | 4.39 | |
| Recruits recommended for discharge from the service | 554 | 2.60 | 59.12 |
| APRIL, MAY, AND JUNE, 1928 | | | |
| United States naval training station, Hampton Roads, Va.: | | | |
| Recruits received during the period | 663 | | |
| Recruits appearing before board of medical survey | 12 | 1.81 | |
| Recruits recommended for discharge from the service | 12 | 1.81 | 100.00 |
| United States naval training station, Great Lakes, Ill.: | | | |
| Recruits received during the period | [1] 548 | | |
| Recruits appearing before board of medical survey | 20 | 3.65 | |
| Recruits recommended for discharge from the service | 18 | 3.28 | 90.00 |
| United States naval training station, San Diego, Calif.: | | | |
| Recruits received during the period | [2] 765 | | |
| Recruits appearing before board of medical survey | 34 | 4.44 | |
| Recruits recommended for discharge from the service | 34 | 4.44 | 100.00 |
| United States naval training station, Newport, R. I.: | | | |
| Recruits received during the period | 898 | | |
| Recruits appearing before board of medical survey | 45 | 5.01 | |
| Recruits recommended for discharge from the service | 27 | 3.01 | 60.00 |

[1] Report not available. [2] Report not received.

## ADMISSIONS FOR INJURIES AND POISONINGS, SECOND QUARTER 1928

The following table, indicating the frequency of occurrence of accidental injuries and poisonings in the Navy during the second quarter, 1928, is based upon all Form F cards covering admissions in those months which have reached the bureau:

| | Admissions, April, May, and June, 1928 | Admission rate per 100,000 per annum | Admission rate per 100,000 year 1927 |
|---|---|---|---|
| INJURIES | | | |
| Connected with work or drill | 711 | 2,475 | 2,913 |
| Occurring within command but not associated with work | 451 | 1,570 | 1,821 |
| Incurred on leave or liberty or while absent without leave | 215 | 749 | 1,097 |
| All injuries | 1,377 | 4,794 | 5,831 |
| POISONINGS | | | |
| Industrial poisonings | 9 | 31 | 37 |
| Occurring within command but not connected with work | 37 | 129 | 104 |
| Associated with leave, liberty, or absence without leave | 4 | 14 | 35 |
| Poisonings, all forms | 50 | 174 | 176 |
| Total injuries and poisonings | 1,427 | 4,968 | 6,007 |

*Percentage relationships*

| | Occurring within command | | | | Occurring outside command—leave, liberty, or absent without leave | |
|---|---|---|---|---|---|---|
| | Connected with the performance of work, drill, etc. | | Not connected with work or prescribed duty | | | |
| | April, May, and June, 1928 | Year 1927 | April, May, and June, 1928 | Year 1927 | April, May, and June, 1928 | Year 1927 |
| Per cent of all injuries | 51.6 | 50.0 | 32.8 | 31.2 | 15.6 | 18.8 |
| Per cent of poisonings | 18.0 | 21.2 | 74.0 | 59.1 | 8.0 | 19.7 |
| Per cent of total admissions, injury and poisoning titles | 50.5 | 49.1 | 34.2 | 32.1 | 15.3 | 18.8 |

Poisoning by a narcotic drug or by ethyl alcohol is recorded under the title "Drug addiction," or "Alcoholism," as the case may be. Such cases are not included in the above figures.

The following cases, selected from April, May, and June, 1928, reports, are worthy of notice from the standpoint of accident prevention:

*Gasoline, careless handling of.*—An engine in a motor boat was started immediately after the gasoline tank had been filled. Vapor from gasoline which had been spilled near the engine was ignited by a spark caused by backfire from the motor. A seaman received severe burns of the face and spent 5 days on the sick list.

Gasoline which had been used to clean a motor, presumably in a motor boat, was ignited by a spark caused by a short circuit in the electrical system. A private marine was severely burned about the arms and body. Loss of time, 30 days.

A flareback occurred when a petty officer who was using gasoline for cleaning purposes threw rags saturated with the fluid into a lighted coal stove. He received burns of both arms. Loss of time, 11 days.

*Hatch cover hazards.*—Through carelessness of others a hatch cover was improperly secured. A man who was passing through the hatch received a fracture of a hand when the cover fell. He was treated in a hospital 39 days.

*Searchlight cover improperly secured.*—A searchlight cover which had been carelessly placed and not properly secured fell and struck a man sleeping on deck. He received a contusion of the leg. Loss of time, 11 days.

*Careless handling of machinery.*—Another person started a motor without warning, while a chief petty officer was adjusting the gears of the magneto. His hands became caught in the gears and the loss of one finger resulted. He was on the sick list 48 days.

A chief machinist's mate received a crushing injury of two fingers when he attempted to change the position of a blower while the machine was in operation.

*Careless handling of gunpowder.*—A private marine serving in Nicaragua was cleaning a room in which a box containing some exposed gunpowder was stored. He dropped a lighted cigarette from his mouth into the box. The explosion caused burns which necessitated 7 days' treatment in a hospital.

*Material not in accordance with regulations.*—Plain glass used in the bridge windows of a destroyer in place of the regulation nonshatterable glass was broken in a heavy sea. The helmsman received severe cuts of the face. Loss of time, 9 days.

*Unsafe practice—Welding metal in an inclosed space.*—Fumes from a welding machine used in a closed room on board a ship caused the poisoning of a shipfitter who was operating the machine. The nature of the fumes was not stated. Loss of time, 11 days. This case was reported as "negligence not apparent."

*Unsafe practice—Lack of eye protection.*—Irritation of the eyes developed after a fireman failed to wear protective goggles, as required by instructions, when working with an acetylene welding torch. Loss of time, 59 days.

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